AGRICULTURAL ENGINEERING

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Volume 14 JULY 1933 Number 7

Engineering and Rural Progress

The Annual Address of the President of the American Society of Agricultural Engineers[1]

By Chas. E. Seitz[2]

AMERICA'S rural progress during the past century does not have a parallel for a like period in any other nation on the globe. The increased efficiency and productive capacity of the farm worker, resulting largely from the application of engineering principles, has, I believe, been the predominating factor in much of our social as well as our economic rural progress. The development of machines to lift the toil from the backs of men and women on the farm and raise their individual efficiency has made possible a much higher standard of living in rural America than is enjoyed by rural people anywhere. It is true that there is still much to be done, but I do not see how further progress is possible by lowering individual efficiency as some would have us believe. Countries having low individual efficiency or productive capacity per worker always have extremely low standards of living.

Chas. E. Seitz

The present serious economic condition of agriculture is quite generally recognized. A large proportion of our farmers are in great financial distress. But in spite of temporary setbacks, such as the present depression, in the long view agriculture has made substantial progress. Farmers have not been making money during the depression; neither has anyone else. Over a ten-year period, however, at least one-third of our farmers have derived a good standard of living from the soil.

We are evidently now entering a new social and economic era. The "laissez faire" attitude will no longer answer. We must learn how to utilize properly all the tools put into our hands by science, and devote more immediate attention to the solution of problems that will give every one an opportunity to enjoy the new leisure made possible by the development of labor-saving machinery.

Agricultural engineering has made valuable contributions to our rural well-being. It has such potential possibilities for even greater service to humanity that I feel we must now give greater attention to social questions. The most important problem before the world right now, it seems to me, is to learn how to distribute properly what we have produced. Greater security of employment and a more equitable distribution of wealth are also important social problems demanding solution. These are problems worthy of the best efforts of engineers and scientists in general. The suggestion has been made that this society found a section on human relations. I heartily endorse such a proposal, and trust that such action will be taken at this meeting.

During times of depression such as we have been experiencing the last few years, the cry is always raised that increased efficiency and overproduction are the direct causes of our woes. During this particular depression much blame has been put upon engineers and scientists in general for the difficulties in which we find ourselves. The charge has been made that increased efficiency and increased production, the direct results of science and engineering, are the major causes of the depression.

It does not seem logical to talk of overproduction causing our woes when such a large percentage of the world's population is without the bare necessities of life. It is true that largely because of the inflationary measures caused by the war, production in all lines was greatly stimulated. The inevitable after-war deflation threw millions out of work and cut down consumption to such an extent that our production has been greater than our capacity to consume. Dr. G. F. Warren, agricultural economist of Cornell University, refutes the charge that increased efficiency and overproduction are the major causes of the depression. In a recent address he said:

"The depression is not due to overproduction or to increased efficiency. Neither American nor world production per capita has been increasing at the prewar rate. For 75 years before the war the production of all basic commodities per capita in the United States increased at the compound rate of 1.73 per cent per year. From 1915 to 1929, it increased only 0.64 per cent per year.

"In 1930 we had the lowest corn crop in 29 years and the lowest production per capita of which we have a record, yet corn fell in price but did not fall as much as other basic commodities. This year the corn crop is large. The wheat crop is the lowest production per capita since 1866.

"It is true it is difficult to sell. It is also true that we have considerable stocks of cotton. These are results of the depression and not causes of it. Because of the depression, little clothing is being purchased, and cotton stocks are accumulating."

In the last 30 years the increased efficiency resulting from the development and improvement of machinery has lifted the level of our living to standards never previously approached. Labor-saving machinery generally has created an unending variety of new occupations, and on the whole

[1]An address delivered before the 27th annual meeting of the American Society of Agricultural Engineers, at Purdue University, Lafayette, Indiana, June 1933.

[2]Professor and head of the department of agricultural engineering, Virginia Polytechnic Institute. Mem. A.S.A.E. President of the Society, June 1932 to June 1933.

has increased rather than diminished the number of jobs. In spite of a substantial reduction in child labor a larger percentage of our population was employed in 1930 than in 1870. During this period, while our population increased 200 per cent, jobs increased 300 per cent.

I do not have any sympathy with the idea that our difficulties are due to the efficiency which industry and agriculture has developed. We need greater efficiency, not less. It is all too evident that our present troubles are due primarily to the World War. It is an inexorable law of nature that we always pay for our excesses. With most of the leading nations of the globe devoting all their energies for four years to the destruction of life and property, it is little wonder that we are now paying for such destruction. The immediate results of war are always a general breaking down of morals, a breeding of selfishness and greed, excessive speculation, unsound inflation and its inevitable deflation. In fact, the social and economic consequences of war are often more destructive than war itself.

Agriculture is always the greatest sufferer from war and its aftermath. The following quotation taken from the recent report of American Engineering Council on the balancing of economic forces bears this out:

"By its very size agriculture is a preponderating factor in the market for goods. Its well-being is vital to national prosperity. However, it is inherently unstable; and because of its peculiar exposure to the evils resulting from war financing and war production policies, it is now in a situation of distress which is the primary cause of the lowering of the attainable standards of living, and in the uneven distribution of wealth."

This report, in my mind, gets right down to one of the important causes of our difficulties, when it states:

"The monetary factor is a primary cause of business instability, and a contributory cause of the unsatisfactory scale of living and of inequality in distribution.

"War inflation is by all odds the most serious form of monetary disturbance. It is primarily a credit factor, and only secondarily a gold phenomenon. No great war has been financed without credit inflation, and until some other way is found there is a grave question as to whether the distresses of the succeeding deflation do not in their sum exceed the physical and spiritual miseries of the armed conflict.

"If we would avoid this greatest cause of instability, of scales of living reduced below the attainable standards, and of unfortunate spreads in the distribution of wealth, war with its accompanying inflation and its inevitable deflation must be prevented."

ENGINEERS AND SCIENTISTS CANNOT BE BLAMED FOR THE DEPRESSION

Wars and the inevitable depressions are caused by the shortcomings of human nature. We must look to the right human nature for peace and prosperity. Certainly engineers and scientists cannot be blamed for the fact that political and social progress has not kept pace with the application of physical science to the work of the world. Let us hope that from present conditions will come a greater realization of the responsibilities and opportunities of political science and sociology.

Patrick Henry once said in the Virginia convention, "I have but one lamp by which my feet are guided, and that is the lamp of experience. I know no way of judging of the future but by the past." The past century in American agriculture has been a period of marvelous progress. And just as surely as agriculture has passed through previous periods of depression and emerged greater than ever, it will recover from its present difficulties and go forward to greater and greater progress. In times like the present, when many of us are likely to lose faith in the future, it should do us good to turn back the pages of history and refresh our minds as to the progress that has really been made in rural America.

A century ago 80 per cent or more of our people lived on farms. At least four out of every five persons gainfully employed in the United States at that time were engaged in agriculture. Human labor was relied on almost entirely to cultivate and gather crops. Oxen provided much of the power for the heaviest farm work such as plowing and cultivating. It was a life of drudgery, privation, and heartbreaking toil. Homes were crude with few if any conveniences. Women labored in the fields along with the men, and at the many household tasks, making their own clothes and utilities. The threat of famine was ever present. Scientific agricultural knowledge was then in its infancy. There were few agricultural periodicals, and only two or three agricultural schools and few experimental farms in existence. No special aid to agriculture was given by the government.

History records little improvement in the implements of agriculture from the dawn of civilization until about a century ago. Up to about 1831 the most important improvements in farm equipment were the substitution of the cradle for the old-time sickle and the cast-iron plow for the old wooden moldboard plow. The invention of the reaper in 1831 closely followed by the first steel plow in 1833 and the thresher in 1834 solved the agricultural problem of the food supply and were the forerunners of the development of farm machinery. It was not until about 1850, you recall, that horse-drawn farm machines were adopted to such an extent that fear of famine no longer haunted the country. It is generally accepted that the year 1850 marked the close of the hand-power era of our agriculture.

AMERICA'S FARM POWER PLANT INCREASES RAPIDLY

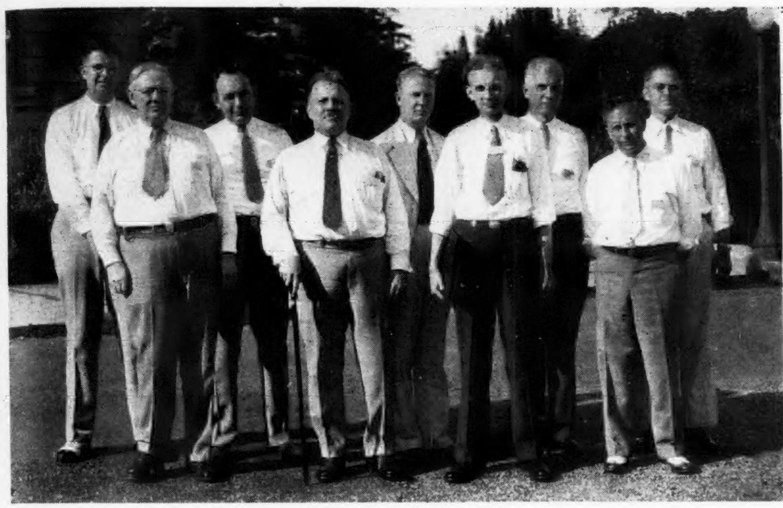
The period from 1850 to 1900 was truly the horse-power era of farming. From a primary power plant of 6½ million horsepower (all animal power) in 1850 there was an increase in the next 50 years of 17 million horsepower, or a total of about 23½ million horsepower in 1900, through an increase in the number of work animals, the greatest increase being between the years 1870 and 1890. The extended use of horse-power farm machinery made possible the abandonment of poor land and the development of better lands for farming. Thus with the improved methods of production and better lands, more and more men were relieved from the need of producing the bare necessities of life and were enabled to turn their attention to the arts and sciences, to industry, or to whatever pursuits they felt they were best fitted for. With the release of men from the soil, America literally leaped forward in its progress.

The following quotation[3] gives an unbiased opinion of the influence of farm machinery on production and labor up to 1900.

"The primary purpose and usual effect of the use of any machine, is the production of utilities at a less expenditure of time, energy, and money. But this is only another way of saying that, when aided by machine power, a given expenditure of time, energy, and money will produce a greater quantity of utilities. Utilities are the means of satisfying wants; and the satisfaction of wants is essential to life and happiness. The use of machinery, by supplying wants, does, therefore, one of two things: either it enables a larger number of persons to get a living, or it enables a given number to get a better living. Anyone will, I think, admit that the utilities supplied by machine power have not all been consumed in better living. A very great part of this additional means of satisfying wants has been devoted to the maintenance of a more numerous population. That this is true must be self-evident when we consider how greatly the supply of utilities has been increased by the use of machinery, and how utterly impossible it would be for the labor force now in existence, unaided by machinery, to provide even the ordinary necessities of life as we now count necessaries.

"By lightening the tasks of those who labor with their hands, and by increasing the quantity of the necessaries

[3]"The Influence of Farm Machinery on Production and Labor," by H. W. Quaintance, published in 1904.



A.S.A.E. Official Family

The group at the left are officers and members of the Council of the American Society of Agricultural Engineers attending the recent annual meeting of the Society at Purdue University. Front row (left to right): Arthur Huntington, president-elect; K. J. T. Ekblaw, incoming second vice-president; Raymond Olney, secretary-treasurer; Chas. E. Seitz, retiring president. Back row (left to right): Hobart Beresford, councilor; L. J. Fletcher, past-president; R. W. Carpenter, outgoing second vice-president; Theo Brown, councilor; E. E. Brackett, councilor

of life which a given amount of labor can procure, machinery has not only favored a higher standard of living, but has increased the chances of attaining it. Moreover, the use of machine power has made it possible for many now to devote themselves wholly to intellectual pursuits without involving either the enslavement or the degradation of others.

"Looking at the question from the standpoint of the whole social body, there can be no other conclusion than that the use of machinery, by increasing the supply of utilities and by making utilities more accessible, has opened the way to a greater number, not only to live and to work, but to develop themselves and to make the most of themselves which their inherent qualities may allow."

The following statement[4] made in 1908 gives us a good idea of the social and economic effect of farm machinery upon the West during the horse-power era of agriculture.

"Socially, economically, and politically, the effect has been far-reaching and revolutionary. The vast levels of the Northwest have become the chief seat of our agricultural production, and the center of political power in the United States. The new instruments of labor have everywhere reduced to a minimum the old-time drudgery of the farm; the storm and stress period of pioneer life has become a matter of history. By bringing to them this opportunity for larger prosperity and leisure, agricultural machinery doubtless saved the farmers of the West from sinking into a peasant class.

"With prosperity and leisure came a taste for culture and the consequent development of academies, colleges, and universities. The farmer on his broad western acres is in considerable measure independent of the exorbitant wages formerly demanded by men who worked only during the harvest season; he is industrious, intelligent, effective, has a wide outlook on life, and takes a high stand among his fellows. The humblest urban wage-earner has in turn had his benefit; the supply of food has been maintained, scarcity has been prevented, and prices are lessened; while wheat, now raised and harvested far more economically than before, can be obtained as cheaply as once were the coarser grains and is now common to all. The introduction of improved agricultural machinery has made possible, also, the great flouring industries of the Old Northwest; and has promoted the prosperity of great railway systems that gridiron the prairies and plains, and of monster fleets of vessels that plow the Great Lakes, all engaged in transporting to market the products of the farm.

"Nor are these advantages confined to America. Wherever, throughout the world, have gone the reaper and its lusty following of labor-saving inventions, life is easier than it was before, and rustic man is no longer slavishly bound to the grinding burden of the sickle and the hoe. His labor has been made vastly more productive, and this means better things in every walk of life."

Engineering has contributed greatly to agricultural production methods and rural life during the period from 1900 to 1930. During this period, which we speak of as the mechanical power era of agriculture, the American Society of Agricultural Engineers came into existence. It has played a most conspicuous part in rural progress, not only in the development of more efficient power and machinery, but also in the fields of irrigation, drainage, soil erosion control, farm structures, and rural electrification.

During this period we have seen the internal-combustion engine come into use as a new form of power. The stationary gas engine, tractor, motor truck, and automobile by 1910 were being adopted for farm use, and by 1920 the tractor had become a formidable competitor of the horse. Animal power reached its peak in 1919 when work animals numbered 26,436,000. By 1930 work animals had decreased to less than 18,762,000, but tractors had increased from 4,000 in 1919 to 846,162 in 1930. Trucks on farms had increased from 139,169 in 1920 to 900,385 in 1930, and automobiles from 2,161,362 to 4,134,675. The average of approximately 1.5 horsepower per agricultural worker in 1850 was increased to about 6.7 horsepower in 1930. From 1900 to 1930 agriculture had added some 40 million horsepower to bring its total to about 65 million horsepower. A total of nearly 17,000,000,000 horsepower-hours was utilized on farms in 1930. Of this total, animals furnished approximately 50 per cent; tractors, 24 per cent; trucks, 10 per cent; electric power, 4.9 per cent; gas engines, 4.7 per cent.

In 1830 the approximate labor requirements in the production of one acre of wheat by hand labor methods was 57.7 man-hours. This had been decreased to 8.8 man-hours by hand and machine methods in 1896, and to 3.3 man-hours by all machine methods in 1930.

From an estimated 15 acres of crops that the average agricultural worker raised before the Civil War, we now have an average of about 36 acres per agricultural worker for the United States as a whole, and in some states the average is over 100 acres. As compared to a century ago when four out of every five persons gainfully employed in the United States were engaged in agriculture, in 1930 largely because of the use of machinery, only about one in five were required.

That technical engineering skill has played an increasingly important part in farm machinery development in the

[4]R. G. Thwaites, 1908, "Proceedings of the State Historical Society of Wisconsin."

last 20 years is very definitely shown in the recent outstanding "Report of an Inquiry into Changes in Quality Values of Farm Machines Between 1910-1914 and 1932," by J. B. Davidson, G. W. McCuen, and R. U. Blasingame. As stated by the authors:

"Today more than ever before competent engineering personnel, high engineering standards, and well-equipped laboratories and experimental facilities characterize the manufacture of farm machines. Only a few decades ago the designing of farm machines and of the improvements in them was rather generally in the hands of men who, although they had outstanding mechanical ability, were not technically trained for that work. Today these problems are most frequently entrusted to men who have both unusual mechanical ability and the best technical training."

The following statement by Mrs. Norma Knight Jones[5] at a recent farm meeting in Topeka, Kansas, well expresses what the present-day farm machine has meant to the farm women and a higher standard of rural life:

"Perhaps no other person has so profited by the machine age as the farmer's wife, and fortunately the farm woman is the dictator of her machine and not the slave of it. The whole ritual of housekeeping on the farm has been made easier and less demanding on physical strength. The giant combine has dispelled the annual orgy of cooking to feed threshers, and no man in the world can eat as much as a thresher. It was one of the tragedies of farm life some years ago that the woman had no time for beauty. And no one of us can live without some beauty if we hope to call it life at all. Perhaps no one has more opportunities for the exquisite beauty of nature than a woman on the farm and today she has time to enjoy it."

As soon as we come out of our present difficulties we will no doubt see even greater progress in raising the standards of rural life. Engineering and science will play an even more important part in the progress of the future. Individual efficiency will be greatly improved and the benefits of such efficiency will be distributed over a larger proportion of our rural population. We will see electrical power, for instance, revolutionizing agriculture and rural life even to a greater extent than other forms of power have done to date. With electrical power furnishing only 4.9 per cent of the horsepower-hours utilized on farms in 1930, the opportunity of this form of power contributing to the welfare of agriculture is practically unlimited.

During the past half century the electrical industry has grown from infancy to one of great importance, probably second only to that of agriculture. The electrical engineer has been largely responsible for much of the progress in this development. He has designed and built large generating stations, high-tension transmission lines, motors and generators that have made it possible to extend electric service to many farms and rural communities.

There does not seem to be any record of where or when the first farm received electric service. The real beginning of rural electrification, however, on a more or less extensive scale, was in California some thirty or more years ago. By 1923, when the national Committee on the Relation of Electricity to Agriculture was organized, California farms were using over 500,000 horsepower in electrical energy, largely for irrigation purposes.

The agricultural engineer has played a conspicuous part in the national organized program of research and development of the application of electricity to agriculture. The research studies conducted by agricultural engineers of the experiment stations in over twenty states, in cooperation with farmers and rural service engineers have developed many profitable applications of electric power to farm tasks. Such studies have demonstrated that by the intelligent use of electricity time and human labor can be saved, productive work can often be accomplished more efficiently, and costs materially reduced. Largely as a result of the work of agricultural engineers over 200 uses of electricity on farms have been listed, and some 300 bulletins and reports have been published dealing with various phases of rural electrification.

In the brief space of nine years we have seen the number of farms served by high lines increased from 177,661 at the beginning of 1924 to 705,075 by January 1, 1933. Add to this the farms with individual light plants and we have 1,000,000 farms or more using electricity.

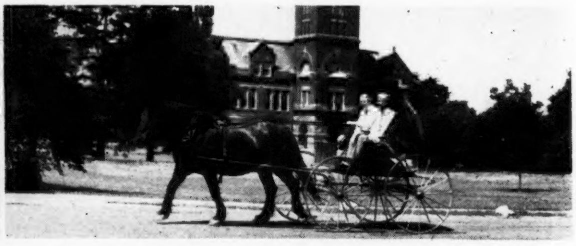
In spite of the general depression in agriculture the use of electricity on the farm has increased in the last two years. This source of energy is suitable for such a variety of uses on the farm and in the home that it has already had a very marked effect on agriculture and rural progress. Its potential possibilities are so tremendous and essential to sound rural progress and improved standards of living that it is of the utmost national concern that electric power rapidly be made generally available to our rural population on a reasonable basis.

Though progress has been made in the economic phases of farm electrification, the real contribution of electricity to agriculture is in the social phases. That is the effect on farm and rural living standards. The electric water system, washing machine, ironer, refrigerator, electric stove, vacuum cleaner, and such equipment has already relieved the farm women of much arduous and exhausting labor and has given them opportunity for leisure, recreation, and added joy in life. Many of us are finding that money is not the sole measurement of accomplishment and happiness. After all the farm and farm home is first of all a place to live and electricity makes it a better place in which to live. With only a little over 13 per cent of our farm homes yet electrified, the real work in this field lies ahead of us.

Land drainage was the first agricultural field of activity to which the engineer turned a major part of his attention in this country. The enactment of state drainage laws, the perfection of excavating machinery, the formation of drainage associations, the design and construction of drainage works, the state and national research and extension work, were all mostly the work of engineers. Largely as a result of the activities of engineers there is perhaps a greater volume of scientific drainage information available than that of any other field of agricultural engineering.

Land drainage has transformed a considerable portion of formerly worthless wet lands into the most productive

[5]Hoards Dairyman, December 10, 1932.

(Left) Retiring President Chas. E. Seitz of the A.S.A.E. is shown "turning over the reins" of his office to President-Elect Arthur Huntington (in the "buggy"). (Right) Arthur Huntington and William Aitkenhead try out the buggy, which may have been built by Arthur's grandfather—a carriage builder of a bygone age

lands of our nation. It has been an important factor in increasing the returns from the land by increasing yields and preventing excessive losses in wet years. Drainage has been of particular benefit to the public through increased healthfulness, because of the abatement of malaria by the elimination of swamps and stagnant waters, and through improved highways. It has made possible a large increase in taxable property and has been an important factor in increasing the wealth of the nation. The contribution of the engineer in the field of drainage has enabled thousands of farmers to prevent loss of crops in wet years, thus increasing their incomes, which in turn has enabled many of them to improve their living conditions.

Before 1870 about 919,197 acres were in drainage enterprises. By 1930 drainage enterprises had been established in thirty-five states providing outlet systems for 84,408,093 acres. In addition, the last census lists 44,523,685 acres of farm lands provided with drainage. It has been estimated that the total capital invested in land drainage in the United States is at least 1½ billion dollars. A large part of the investment in drainage enterprises has been made by drainage districts organized and operating under laws based upon the results of investigations by engineers of the Federal Bureau of Agricultural Engineering.

Our drainage is by no means complete. It has been estimated that some 30,000,000 additional acres require outlets before lateral drains can be installed. It is difficult to estimate the field of underdrainage. We know, for instance, that of the area of farm land drained, only a small part of it is completely underdrained. As economic conditions become normal, the need for underdrainage will become more urgent. It has been estimated that some 75,000,000 acres of overflowed or swamp lands in the United States will some time justify the cost of drainage. No doubt considerable progress will be made in the next few years in the adoption of specific policies of land utilization, and it is probable that it will be found desirable to substitute much of our rich reclaimable land for the higher priced but worn-out farm lands.

The development for agricultural use of rich bottom lands, and the growth of industrial sections of some of our larger cities along the banks of streams has intensified the need for flood control. Considerably over a billion dollars in property value and the loss of hundreds of lives in the past 30 years has brought the importance and value of flood control measures closer to the public than ever before. The engineering works that have already been constructed to control floods, such as the construction of detention basins and channel improvement in the Miami Conservancy District, are good examples of what can be done to control floods. Such works have been of great social and economic value and have stimulated the flood-control movement.

ENGINEERING HAS AND WILL PLAY AN IMPORTANT ROLE

In many river valleys throughout the country the agricultural and industrial development justified flood protection methods on economic grounds, while future development will require more and more of this work. The present national administration clearly recognizes the obligation of the government to foster and encourage the development of our national resources for the benefit of all the people. The present policy in this regard gives hope and encouragement to great sections of our rural population. Engineering will no doubt play the predominant part in much of this development and thus further contribute to the nation's welfare.

Engineering in the field of irrigation has been one of the predominant factors in the development of our great western country. In fact, water is the dominating factor in the development of the West, and through irrigation a western empire has been made possible. The social as well as the economic well-being of the West is intimately interwoven with irrigation. On the federal irrigation projects alone, which constitute only 7.6 per cent of the total area in irrigation enterprises, homes have been established for some 600,000 people. There are 685 schools and 683 churches on these projects, while the value of the crops grown in one normal year is about sufficient to pay off the entire indebtedness of these projects to the government.

Irrigation in this country began as an economic necessity, when in 1847 the Mormons in Utah first diverted water from the creeks to irrigate their crops. While the early pioneer built small diversion weirs and short canals for irrigation, it was not until engineering science was utilized that great progress in irrigation was made. The engineering design and construction of great dams on the many river systems of the West is generally recognized as one of the greatest contributions that has been made to the development of the West. Such projects often served the combined purpose of storing, diverting, and conveying water to arable lands, and the generating of hydro-electric power and water supply.

AGRICULTURAL ENGINEERS MAKE NOTABLE CONTRIBUTION TO IRRIGATION

From the small beginning in Utah in 1847, irrigation was soon practiced in all the western states. By 1889, according to census reports, 3,715,769 acres were irrigated, and by 1929, there were 19,547,544 acres under irrigation in the 19 western states. Irrigation enterprises in these states had a total investment of $1,032,755,790 in 1930. The outstanding phases of irrigation development in the last decade has been that of pumping for irrigation, as a substitute to other methods in some instances, and as a supplement to them. The investment in pumping enterprises in 1930 was 53.6 per cent of the investment in all irrigating enterprises. The area served wholly or partly by pumped water in 1929 was almost double that reported in 1919, and 31.1 per cent of the entire area irrigated in 1929, as compared with 16.2 per cent in 1919. Yet with all this development it is estimated on the best of authority that only about 50 per cent of the ultimate irrigable lands of arid regions has been utilized.

Agricultural engineers at the state colleges and with the federal government have made notable contribution to the science of irrigation. A mass of technical and practical information has been published. The results of their researches have returned millions of dollars annually to farmers of the West. The results of the duty of water studies by the U.S.D.A. Bureau of Agricultural Engineering in California alone have saved the single industry of citrous fruit production $4,000,000 annually, not to mention the added value of the product.

During the last decade we have seen a considerable development of irrigation in the humid eastern states. Overhead or sprinkle irrigation for intensive truck crops has become quite general practice among our more progressive truckers. Surface irrigation of orchards and some field crops has also been practiced in recent years with such results that this practice is certain to expand and develop in the future. We will no doubt see irrigation practices greatly extended in the eastern states.

Agricultural engineers have pioneered in the development of methods to control soil erosion which represents one of our greatest wastes of natural resources. It is estimated that 75 per cent of the cultivated land of the United States, or some 300 million acres, is affected by erosion and that over 23 million acres of formerly cultivated land has already been eroded to such an extent that it cannot be reclaimed for agricultural use.

The rapidity and extent of erosion is realized when we consider the state of Oklahoma which had practically no land in cultivation prior to 1890 and the greater part of its 16,000,000 acres now under cultivation have been placed in use since 1900. The Oklahoma Agricultural Experiment Station reports that 1,359,000 acres of land in that state have been abandoned as a result of soil erosion, and that 6,000,000 acres are gullied. Some 374,000 acres are cut with gullies so deep as to prevent crossing with farm machinery.

Unrestrained erosion not only means the loss of the soil itself and the eventual abandonment of the land for farming purposes, but it is also a primary cause of rapid run-off and the clogging of stream channels, thus contributing to flood causes. This great loss caused by erosion is not only a direct loss to the farmer and his family but to society as a whole and to posterity. Future generations will pay dearly for this tremendous waste of the real sources of the nation's wealth.

Some progress has been made in combating the loss of agricultural lands from soil erosion, although compared to the magnitude of the problem only a beginning has been made. As far back as 1903-4 studies were made of hillside erosion by the division of drainage and soils of the U.S.D.A. Office of Experiment Stations. Studies of terraces to check soil erosion were started in 1914 by the division, after it was transferred to the Bureau of Public Roads as the division of agricultural engineering. The present Bureau of Agricultural Engineering, in cooperation with the Bureau of Chemistry and Soils and the state agricultural experiment stations, is conducting investigations in erosion control at ten soil erosion experiment farms.

Much valuable basic information has already been collected at these and other stations and has made possible the better design of terraces to control erosion. The effectiveness of terraces as a means of controlling erosion has been conclusively demonstrated on the soil erosion farm at Bethany, Missouri. For example, L. A. Jones reports that unterraced land with an 8 per cent slope planted to corn lost by erosion approximately 104 tons of soil per acre, while the average loss from five terraced acres of the same slope planted to corn, lost only 2.8 tons of soil per acre. In other words, more than 37 times as much soil was eroded from the unterraced area as was lost from the terraced area.

Largely as a result of the educational work conducted by extension agricultural engineers in a number of our states, some 15 million acres have been terraced on 300,000 farms during the past ten years. This work is now being advanced at the rate of about 2 million acres terraced yearly. Farmers believe that terracing increases crop yields to the extent of at least $2.00 per acre per year. The average increased value of terraced land has been estimated at $6.00 per acre. The educational terracing program has, therefore, increased the value of the land on these farms at least $90,000,000 and the annual returns at least $30,000,000, or an average increased income of $100 per farm.

ENGINEERS CONTRIBUTE TO DEVELOPMENT OF MODERN FARM STRUCTURES

While this all represents real progress, there remains much to be done. This work is of vital importance to agriculture and society as a whole. The terracing program must be given greater national support and recognition. This is a field worthy of the utmost efforts of agricultural engineers. There will no doubt be much progress in erosion control measures in the next decade.

Until agricultural engineers turned their attention to the vast field of farm structures, little improvement was made in the development of better designs for farm buildings. The early settlers used the materials nearest at hand for their few crude structures. In the wooded sections log buildings were the rule. On the prairies the buildings, which were only the barest of shelters at the best, were made mostly of sod and adobe. Such structures are intimately connected with the early agricultural history of our country.

Buildings are an important item in the economical operation of the farm. Their proper design and construction are necessary to assure efficient service and success of the farming enterprise. Buildings represent a permanent investment exceeded in value only by the land itself. The 1930 census figures show that buildings represented 22.6 per cent of the value of all farm property. The value of buildings on our farms was $3,556,634,000 in 1900. By 1930 this value was $12,949,994,000. Farm buildings increased in value over one billion 200 million dollars from 1925 to 1930, but land and machinery decreased in value nearly 3½ billion dollars during this 5-year period.

Real progress has been made in the design of livestock, storage, and other utility buildings for the farm. The extended use being made by farmers of the plan services of the agricultural engineering departments of the various state colleges is evidence that progress has been made in planning better structures for the farm. A recent development of great value is the establishment of the regional farm building plan exchange service sponsored by the Structures Division of the Society. This most commendable service is making available to all state agricultural engineering departments and extension services such plans of farm buildings and equipment, prepared by other cooperating agencies, as may be mutually applicable to their respective state plan services. This service will operate to eliminate duplication of effort and expense in the preparation of plans and to promote a wider distribution of new designs. It will be of especial value to states which do not have facilities for producing building plans.

THE FARM HOME IS RECEIVING THE ENGINEER'S ATTENTION

Our major emphasis has so far been given to farm buildings other than the house. It seems to me that we must now turn our major attention to the farm home. When all is said and done the home is the center of the nation's social structure. It is the very foundation of our commerce and industry. The personal ambition of most of us is for better homes. Our agriculture and our rural life are clearly in the process of reconstruction. We are witnessing a great migration of our people back to the land. No doubt a much greater proportion of our population in the future will be rural. If this trend is accompanied by a sound decentralization of industry, it will be for the good of the nation. We as agricultural engineers have an obligation, as well as an exceptional opportunity, to contribute further towards the enrichment of rural life by aiding rural home improvement.

The ideal as stated by W. A. Foster is that "every farm house have an abundant supply of running water, an adequate lighting system and sunlight, an efficient means of heating, and a beauty in the architecture and surroundings that would give inspiration to the occupants."

Only 15.8 per cent of farm dwellings had water piped into them in 1930 and only 8.4 per cent had water piped into bathrooms. Some 13.4 per cent were lighted by electricity and probably a much smaller percentage had adequate heating systems. We, therefore, have a big field for service in the improvement of farm home conditions.

* * * *

In the field of education, agricultural engineering has contributed to the social as well as the economic well-being of agriculture. The aim of the objective in agricultural engineering education as set forth by our Society has been directed toward "creating a desire for and the capacity to enjoy higher standards of living, better working conditions, adequate educational facilities, and equitable social progress for those engaged in the industry of agriculture." Agricultural engineering has made substantial progress toward this objective.

Resident instruction in agricultural engineering was first organized by a state university 29 years ago. Now practically all the land grant colleges in the United States recognize agricultural engineering, either by offering special courses of instruction or by providing for separate departments which, in addition to resident instruction, conduct research and extension work in this field. The first bachelor of science degree in agricultural engineering was conferred in 1910. By 1932 twenty institutions reported agricultural engineering curriculums leading to this degree. Not only by training engineers to serve agriculture, but by the instruction of county agents, agricultural high

school instructors, future farmers, and other agricultural leaders in the application of engineering to agriculture, this educational work has no doubt had far-reaching effect on the improvement of rural living.

Agricultural engineering research at the state experiment stations has expanded gradually from practically nothing 27 years ago to a program numbering 490 projects at 45 of the 60 experiment stations in 1933. The funds assigned for these research projects are a very small part of the money appropriated for all agricultural research However, the results obtained from this research to date should assure more adequate support in the future. Beginning about 1899 with investigations of irrigation and drainage problems, in the federal department of agriculture, we have seen the scope of federal agricultural engineering research gradually widened, until today it also includes power and machinery, soil erosion control, farm land development, and farm buildings, all organized under a bureau of agricultural engineering.

Organized agricultural engineering extension work was begun about 1914. By 1933 there were 65 extension agricultural engineers employed by state agricultural extension services in 32 states to aid farmers in the judicious selection and utilization of engineering practices. Furthermore, every state is conducting one or more lines of engineering extension work. Many examples could be given to show how the work of these extension engineers, who carry the latest results of research and teaching directly to the farm people, has contributed to the social as well as economic well-being of agriculture.

For example, a recent statistical summary of results of cooperative extension work reports 803,889 farms adopted improved engineering practices during the six-year period 1924 to 1929; 29,697 families were assisted with house planning problems during 1930 and 1931; 21,724 dwellings were constructed and 30,464 remodeled from 1923 to 1931. During this period 36,278 sewage disposal systems, 32,570 water systems, 5,763 heating systems, and 29.801 lighting systems were installed.

Agricultural engineers in general have in the past recognized the social benefits of their work to farmers, and in many instances these benefits have gone along with the economic program. The farmer who has enjoyed the results of efficient farming, with its better standard of living, brought about in a large measure by the adoption of engineering principles, has been quick to grasp its social benefits and is most reluctant to give up such benefits. As evidenced by his increased use of electricity in the last two years he is going to be on the lookout in the future for engineering suggestions containing ideas of social as well as economic improvement. I trust that we will be prepared to be of even greater service to the farmers of tomorrow, and thus further contribute to rural progress in the years ahead.

Results of Recent Farm Tractor Fuel Studies[1]

By C. G. Krieger[2]

DURING the past several months four makes of tractor engines have been tested with the object of obtaining fundamental data regarding the overall operating efficiency of these engines, with special regard being paid to the thermal efficiency and the volumetric efficiency under actual operating conditions. Each of these engines was operated on several different grades of fuel, ranging from the lower grade distillates up through the grades of gasoline. In each case the optimum compression ratio and the proper fuel induction system were employed for the particular fuel which was being tested. The average results were as follows:

By changing the accessories of the stock engines so as to give maximum efficiency on the better grades of gasoline possessing high anti-knock value there was an average increase of 27 per cent in brake horsepower, an average increase of 24 per cent in torque, and an average improvement of 26 per cent in fuel economy.

It is conservative to estimate that the overall efficiency of the average tractor engine could be increased from 20 to 25 per cent by designing them to run exclusively on standard grades of gasoline. With the present type of design, which permits operation on either low-grade fuels or on gasoline, the efficiency of present-day tractor engines is far below that of present-day automotive engines.

All the tests which have been run thus indicate that, when gasoline is used instead of low-grade fuels, the life of the lubricating oil is increased from two to three times. While this factor itself is of vast economic importance, it is impossible to estimate the ultimate economy from the lubrication standpoint, since in the final analysis the measure of the lubricating value of an oil is in the amount of wear taking place in various parts of the engine itself over a given period of time, and not in the chemical analysis which would indicate the depreciation of the oil. It is believed that, if tractors were equipped with gasoline engines and used gasoline exclusively, the excessively rapid cylinder and piston wear, which is current on present models, could be greatly reduced. This statement should be qualified to the extent of saying that it is assumed that the air cleaner would be properly serviced as instructed by the manufacturer.

It was found that the life of the valves in tractor engines was materially increased when gasoline was used instead of kerosene. This condition is brought about by the fact that engines operate much cooler when gasoline is used. These cooler operating temperatures are also a material factor in the reduction of oil consumption.

A considerable amount of experimental work was done with various bores and strokes for an engine of a certain output. This phase of the work has not as yet been completed, but the results thus far would indicate that the size of present tractor engines could be materially reduced, if the engines were designed to run on gasoline. This reduction in size should result in a saving in manufacturing cost, as well as a saving in operating cost.

A considerable amount of work was done on valves, valve materials, and valve seat inserts. The results would indicate that the use of proper valve seat inserts in connection with proper types of valves (assuming the valves are made of good material) would eliminate most of the valve trouble which exists at the present time. It is very probable that the use of valve seat inserts and good valves would make it possible to operate an engine from two to three times longer without the necessity of grinding the valves. The fact that the valves would seat properly for a longer period of time would result in the engine delivering its full power for a similar period of time.

Results of our tests would also indicate that, if tractor engines were designed to operate on gasoline exclusively, the size of the cooling system could be materially reduced, thereby resulting in a saving in the cost of manufacturing.

A material saving could be effected through the use of a regular gasoline manifold instead of the present types of combination manifolds, which are quite expensive to manufacture, but which are quite necessary if low-grade fuels are to be used.

[1]Report presented at a session of the Power and Machinery Division of the American Society of Agricultural Engineers during the 27th annual meeting of the Society held at Purdue University, Lafayette, Indiana, June 1933. A contribution of the Committee on Agricultural Engine Research.

[2]Agricultural Engineer, Ethyl Gasoline Corporation. Assoc. Mem. A.S.A.E.

The Economic Depression as a Challenge to the Agricultural Engineer[1]

By J. Brownlee Davidson[2]

IT MAY APPEAR unnecessary to describe an economic depression at this time when our country and the whole civilized world are grappling with one of the worst depressions of history. However, for the purpose of this paper, an economic depression represents a condition where business is generally unprofitable, industry is paralyzed, business failures are frequent, and unemployment is widespread. If a contemporary description of the present depression fails in any way to adequately picture the worry of financial loss and impoverishment the anguish of business failure and bankruptcy, and the agony coming from a need of the bare necessities of life which prevail during a serious depression, the descriptions of the depressions of 1837, 1857, 1873, and 1893 may be found accurate and applicable.

It might well be pointed out in this connection that depressions are not necessarily a nineteenth century phenomenon. Consider the following statement:

"The government will not only provide funds for relief work but will also open up all storages of accumulated grains and other necessities of life for direct distribution. The lowering of taxation will relieve people from public burdens and thus enable them to be self-supporting. . . . The ban upon private exploitation of publicly owned rivers, forests, and mines will be lifted, and the people permitted to enjoy the products of state property. . . . Restrictions upon imports and exports will be abandoned in times of depression to facilitate free transportation and quick exchange."

The foregoing will be of particular interest to those who pine for the "good old days" before such modern experiences as economic depressions afflicted mankind. The lines quoted were written during the first century A. D. and referred to measures undertaken by the Chinese government under the Chow dynasty to overcome a depression of that period, "to restore prosperity," "to reduce tax burdens," and "to relieve unemployment."

Volumes and volumes have been written concerning the causes and the cures of depressions. In addition to being a subject in which every group of thoughtful citizens should be interested, the agricultural engineer has a special reason to be concerned because the advance of agricultural engineering practice is frequently cited as one of the contributing causes of the present depression. It is the purpose of this paper to inquire into the validity of this contention and suggest what attitude the agricultural engineer might well take toward this great economic problem.

I do not presume to be an economist, but, on the other hand, there are certain ways in which I may qualify for entering into a discussion of the subject. In the first place, experience with two depressions is of some value. It was as a small boy in circumstances tending to instill lasting impressions that I observed the depression of the nineties blend into the better days that followed. Whether the present depression has been more acute and resulted in greater distress than the one which came in the nineties is largely a matter of viewpoint. I am inclined to say that the former was the more severe.

Naturally with my early interest in depressions, I have followed rather closely the literature treating of depressions throughout my life. It is not my purpose or desire to review the whole subject, but rather to present what appears to be the most significant factors and relate these to the ideals and work of the agricultural engineers.

In order to discuss in any adequate way the relation of the agricultural engineer to economic depressions, it would seem necessary to inquire rather fully into the objectives, the purposes, the ideals, and the achievements of the engineer in general, and the agricultural engineer in particular. Perhaps the best starting point would be an accepted definition of engineering. The definition to be found on the walls of the Engineering Societies Building in New York ought to fully meet the requirements of an adequate definition. It reads: "Engineering is the art of organizing and directing men and controlling forces and materials of nature for the benefit of the human race." An analysis of this definition for the purpose of paraphrasing into more conventional terms indicates that engineering deals with labor as indicated by the term "organizing and directing men," power as indicated by the term "the forces of nature," and the materials of construction designated as "the materials of nature." In brief the engineer is a specialist in labor, power, and materials regardless of the particular branch of the profession he may represent. The agricultural engineer is concerned with the application of engineering to the agricultural industries and has the limits of his interests so outlined or defined. Otherwise his ideals and achievements are similar to the engineer in other branches of the profession.

A vital element in the idealism of the engineer is the acceptance of the principle that human well-being has as

[1]Paper presented at the 27th annual meeting of the American Society of Agricultural Engineers, at Purdue University, June 1933.

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its foundation the having of material things with an opportunity through leisure to enjoy them. As soon as this principle is stated, exceptions may be expected. It will be immediately urged that values of life are not materialistic, that it is possible to be rich in material things and at the same time to be spiritually poor, forsooth it is contended that material riches lead to spiritual poverty. In my opinion the examples of the few rich in money and goods, who have become so thoroughly occupied in looking after their wealth, have completely overshadowed the thousands who are poor in goods and likewise poor in spirit. Then again attention should be centered not on the rich with their burdens of wealth but upon the well-to-do with adequate but not excessive wealth. There is nothing I can cite that is incompatible with a great personality and the ownership of adequate material resources. That Jesus, for instance, was a poor man was a coincidence, not a requirement. The same way of life has been followed by the well-to-do and even by the rich.

A significant observation to be made in this connection is that those, who pine for the old situations when life was primitive and simple and when there were not so many worries with equipment, facilities, and conveniences, prefer to have the return to the past apply to others but not to themselves.

The control of the forces of nature and the use of the materials of nature for the making of things contributing to human convenience and comfort is accepted by the engineer as being of "benefit to mankind," and representing a positive contribution to human well-being. If this is not true, then engineering is all a mistake and unsound in concept and purpose. Notwithstanding the occasional expression of views to the contrary, the engineer's conception of the relation of material wealth and well-being will be generally approved by all thinking persons as sound and well-grounded.

The engineer believes that the way to have material things—those commodities and services which contribute to well-being—is to produce them. If there is to be an abundance for all, production per capita must be large. Certainly all cannot have more by producing less. Henry Ford recently stated this principle as "scarcity cannot create plenty." To increase production per capita by increasing the productive output of the individual is one of the chief objectives of the engineer. Just how the work of the engineer affects the productive output of the individual may be worth further consideration.

THREE WAYS IN WHICH THE ENGINEER INFLUENCES PRODUCTIVE OUTPUT

A study of the ways in which the engineer influences the productive output of the individual worker reveals that output is affected in three ways: first, by the multiplying of effort through the substitution of motor energy for muscular effort; second, by the reduction of losses and wastes of effort, and third, by reducing the frequency with which certain tasks must be performed by the introduction of durable construction or methods.

Of these methods of increasing output, the multiplying of individual output by the substitution of motor power for muscular effort is the most effective. In no field of endeavor can better illustrations be found than in agricultural engineering. Consider the tilling of the soil. A man unaided can, with the aid of a spade, prepare about one-tenth of an acre of land. A man at hard work will develop about one-tenth to one-eighth horsepower. With the help of a one-horsepower motor and a plow the output is easily increased tenfold, and so on as the size of the motor is increased. With a 15-hp tractor the output is increased 150 fold.

So significant is the influence of the use of power upon output that statistics reveal that the output per worker, in commodities or products in various states and countries, is directly related to the power used. The power which a worker has available to help him is often compared with slaves. For instance, it is urged that in the United States every person has the equivalent of 35 slaves to help. In the Orient where very little power is used to aid the workers, individual production is very low. This accounts for the fact that the American rice grower has been able to establish his industry in direct competition with the Oriental rice grower, in spite of the wide difference in wage scale. Everywhere you may turn the output of useful productive work is related in a direct way to the amount of energy the worker has at his command; in fact, the rate that we are able to move about from one place to another, either by land, sea, or air, is proportionate to the amount of power used.

There are instances where with an increase of output through the use of power there is a lowering in the quality of work performed, tending to reduce the overall value of the work done. In fact, there has always been an insistence that handmade commodities were best. Admitting that there are illustrations of where this is true, it is not the rule. Hand seeding and planting of grains does not equal either in accuracy or precision the work of machines. Harvesting by machines is likewise a higher quality of performance than hand harvesting. The production of machines can best be carried out by efficient machine production. There are places, notably in the fine arts, where quality and individuality must take precedence over quantity, but in the production of commodities and services for the masses, quantity combined with quality should be the goal.

MAKING LABOR MORE EFFECTIVE BY REDUCING WASTE AND LOST EFFORT

The second way in which the engineer makes labor more effective is by reducing waste and loss in effort. The reduction of rolling resistance through the use of a hard road surface is a good example. The energy required to move a load over a steel rail may be less than one-tenth of that required to move it over a good earth road. Motion studies in general have for their purpose the reduction of waste and lost effort. The reduction of friction losses in machines, the increase of thermal and mechanical efficiencies in heat motors, and an economical use of materials are further examples of the reduction of waste and losses.

The third way in which the engineer strives to increase the output of the worker is by reducing the frequency with which tasks must be performed. With others I visited several of the Crimean cities in the summer of 1929. Early one morning on the way to a train we witnessed the functioning of the city water supply system. A two-wheel water cart with attendants equipped with water pails were making the rounds of the homes leaving water in the jars placed in suitable places. Compare this method of supply with the modern city water supply system, whereby the laying of pipes, a form of container in the ground connecting the supply to the individual houses, the task of moving the containers need not be performed except at long intervals and the energy required to move the water is supplied through a pump.

Through the application of these principles the engineer and engineering methods have been the most important factors in making more material wealth, conveniences, comforts, services, and leisure available for distribution among all the people. This increase in production has taken place until the question is being constantly asked if there is not too much production. And all this leads to a consideration of economic depressions and the relation of the engineer thereto.

A logical starting point in an attempt to relate the work of the engineer to economic depressions would be a list of the accepted causes of economic depressions. It may be questioned as to whether it would be practicable to prepare an acknowledged list of causes and to have the same acceptable to any considerable number of authorities may be looked upon as quite visionary. Anyone having had a continued interest in the phenomenon of an economic depression and who may have been called upon

to review the contemporary literature on the subject, will be impressed that the situation is very much like Mark Twain's remark on the weather: "Everybody talks about it, but no one seems to change it."

Of the various works upon the depression which I have reviewed, the recent book by Professor Irving Fisher, "Booms and Depressions," appears to be the one most understandable and which coincides more nearly with my personal experience and observation. Professor Fisher lists nine causes of depressions which he calls main factors:

1. The Debt Factor
2. The Currency-Volume Factor
3. The Price-Level Factor
4. The New-Worth Factor
5. The Profit Factor
6. The Production Factor
7. The Psychological Factor
8. The Currency-Turnover Factor
9. Rates of Interest.

Most authorities will concede that if overindebtedness is not the main factor in the development of depressions, it has a very significant influence about which all of the other factors radiate. If anything has been learned about depressions by a generation experiencing a depression, it is that of avoiding the economic hazard of debt. No doubt everyone during the current depression has had among his acquaintances elderly friends who insist that the depression of the nineties was very much more severe from their point of view than the present. I have inquired carefully into the reason for this attitude with the invariable result of finding that these individuals had learned their lesson from the former depression concerning debt. Having learned by bitter experience the danger of overindebtedness these men have always avoided excessive obligations and at the present time are in no mood to concede that the present depression can compare in intensity with the former, in spite of the fact that the years tend to soften the pain of former experiences.

There is but one other factor that I wish to discuss further because so much is being said and written about them all. This other factor is the one that concerns directly the engineer and is often cited in criticism of the engineer. I refer to production or overproduction as it is usually stated.

NO OVERPRODUCTION WHILE HUMAN NEEDS ARE NOT SUPPLIED

In every depression, as distinguished from a famine, it has been contended by certain individuals that overproduction was one of the main causes. The principal difficulty in viewing this matter intelligently is to be able to consider the problem in a sufficiently large way. It is conceded that at times there may be more goods or services of a certain kind than can be readily consumed, but who is willing to contend that any adequate approach has been made toward supplying the reasonable wants or needs of the human race?

As long as legitimate desires and needs exist on the part of a large portion of the people, who can say that there is overproduction? Who will insist that the farm homes of the country have too many conveniences and comforts; that there has been too many facilities to occupy leisure time; and that too much attention has been given to the guarding of health? There never was a more fundamental truism than that contained in the axiom that for the people as a whole "they cannot have more by producing less."

Irving Fisher uses a dialogue to reveal the absurdity of overproduction as the cause of the depression. To the person who insists that overproduction is the cause of our trouble, you ask "How do you know it is overproduction?" The answer is "Because there are goods and commodities in store which the people cannot buy." You ask "Why don't they buy?" The answer is "Because they don't have the money." You ask "Why don't they have the money?" The answer is "Because they are not working; factories and shops are idle." You ask finally "Is not this unemployment and non-production?" And thus it is agreed that the paradox exists that non-production is the cause of overproduction.

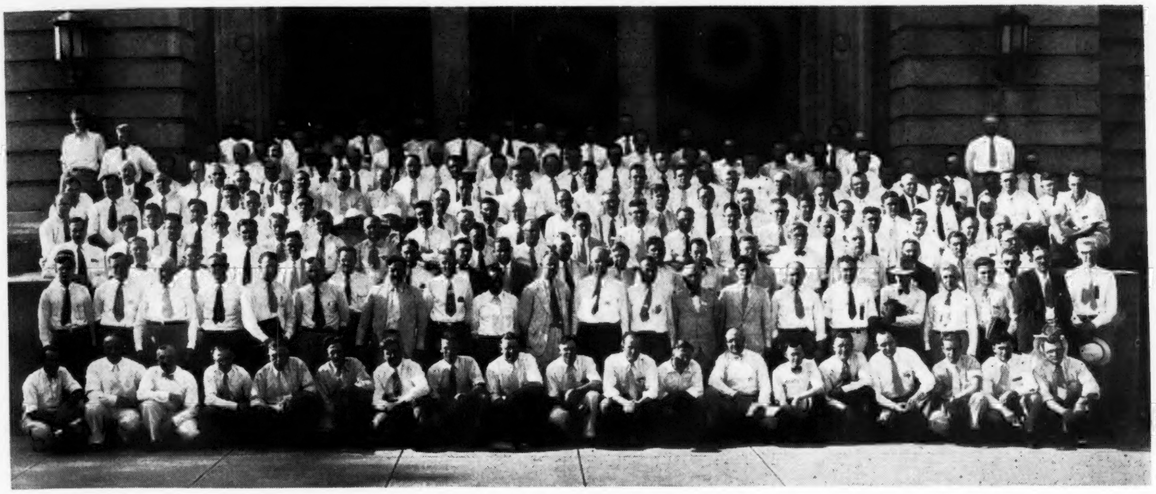
At the time this was written a gigantic national program was being organized to regulate agricultural production, and public opinion seems to support the movement. A fundamental difference should be recognized in the agricultural industry than in manufacturing. In agriculture the competition is wholly between farmer and farmer either at home or abroad. It is recognized that in the United States at least we can produce much more than can be consumed, and the competition between farmers is for the privilege of supplying all that can be consumed. With the advance of productive efficiency due in a large part to engineering, a smaller and smaller percentage of the population is needed. The competition is greatly reduced when economic conditions are so favorable in other industries that workers leave agriculture and thus relieve the internal competition. Such reasoning leads naturally to the conclusion that the best way to secure agricultural relief is to have prosperity in other industries. There is much evidence of the soundness of this conclusion. During the present depression when many of the employed have been turned toward the farm, many observers have pointed out that such a movement would lead ultimately toward subsistence farming and the destruction of manufacturing. Notwithstanding, it is surprising how many opinions are encountered which look upon this back-to-the-farm movement with satisfaction. In fact such a view is shared by some farmers themselves.

AN INTERESTING ENGINEERING VIEWPOINT OF HUMAN WELL-BEING

A study of the advance of well-being with the acceptance of the principle that well-being consists primarily in having material things and the opportunity through leisure to enjoy them must lead to the conclusion that agriculture, the production of food and raw materials used for food, shelter, and clothing, is essentially a burden on the human race and when taken care of the balance of human time may be used for those things contributing directly to well-being. This being true the fewer people in a self-contained community required for agriculture, the higher the standard of well-being, because a larger number of persons will be available for producing the commodities and services needed for the larger measure of well-being.

The problem of distribution is recognized as an essential part of the problem of production. Down through the ages when there was a general want of material wealth, certain individuals had more than they could use. In this land of ours we have followed the principle that the individual could accumulate wealth without limit so long as the rules were observed and the wealth accumulated could be passed on to his descendants. Public sentiment is changing in a remarkable way in regard to what may be right in connection with the problem of great wealth in the control of few individuals. It is not the purpose of this paper to discuss this matter only in so far as it touches production. It now appears to me, however, that society is going to limit the accumulation of wealth in the future. Furthermore, society, I feel sure, is going to demand from the owners of great wealth very definite responsibility for keeping the economic machine running smoothly in return for the privilege of accumulating. In other words, if society is to protect the owner of wealth, the wealth must be used in certain ways at least for public benefit. As to passing wealth on to descendants, there are very definite attitudes being developed, as revealed by inheritance taxes which will resolve itself into laws limiting the extent to which wealth may be inherited. Such limitations would seem to be compatible with our accepted principles and ideals of equal opportunity to all.

Just how to insure a minimum of well-being to all persons of our country when all of the frailties and short-



A group in attendance at the 27th annual meeting of the American Society of Agricultural Engineers at Purdue University

comings of human nature are taken into account appears to be a problem almost beyond solution. It is certainly worthy of the best effort of the best minds in the country.

Most all authorities agree that the severity of a depression is augmented by a large number of secondary influences not directly causative in themselves. Perhaps the most important of these are the psychological influences such as optimism and pessimism and reactions not often based on careful reasoning. For instance, prices are often carried up or down in a price movement when the facts concerning supply and demand do not in a way justify the movement. To illustrate more definitely, an advancing price tends to cause owners of staple commodities to withhold selling in the hope that prices will go still higher.

The country has been flooded with remedies for the depression. Secretary of Labor Perkins reports that two thousand plans for ending the present depression have been turned in to her department. As far as I know, no report of the merit of these plans has been made, but Miss Perkins regards their submission as evidence that an enormous amount of thinking has been expended on the problems of the depression, and this is the first sign of results.

A committee of American Engineering Council has been making a study of business stabilization and has selected and analyzed in a progress report forty distinct causes of depressions, which have been offered, and classified in some detail twenty-three plans for business stabilization out of the many which have been submitted. The committee, however, did not report favorably for any one all-inclusive plan as a preventive or cure. This report should not be taken as revealing a hopeless or fatalistic attitude toward depressions. Not long ago a broker, in conversation, suggested that depressions were a good thing, that they tended to shake down all values to their true worth. It would appear that such an expression could come only from a person who had been able to avoid the trials and the pains of an economic storm.

One difficulty with undertaking to suggest a remedy or a plan for guarding against a future depression is the inability to foresee the situations of the future. It is said that H. G. Wells is busy at work on a future history of the world. To say the least, he is a brave man. It is only necessary to review the literature of a quarter of a century ago to determine to what an extent the prevailing thought of any period may be in error.

In 1906 James J. Hill, the outstanding railroad magnate of his time, prepared and delivered an address to the Agricultural Society of Minnesota. That the views expressed in this address received general approval at the time it was given is evidenced by the publication of the address by many institutions and societies in the United States and abroad. It is to be found as the first chapter of the book "Highways of Progress," under the title "The Nation's Future." In this address Mr. Hill expounded the doctrine of conservation, but urged the necessity for providing against a national calamity or the time when we as a nation would no longer be able to provide an adequate supply of food to feed ourselves.

To illustrate, let me quote some significant passages: "Therefore, and this is the focal point of the whole matter, the country is approaching the inevitable advent of a population of 150,000,000 or 200,000,000 within the lifetime of those now grown to man's estate, with a potential food supply that falls as the draft upon it advances. How are these people to be fed?"

Again, "The single intelligent advance on practical lines made by public authority within the last quarter of a century is the reclamation law initiated and paid for by a few western railway companies; it provides for a real addition to the sources of food supply and the opportunity for employment. But it is only a light breeze blowing in the face of a cyclone. If every project contemplated as feasible were executed, and if all were completed by the rub of a magic lamp, some 60,000,000 acres would be added to the arable national domain. And if only forty acres of this were assigned to each family, it would supply the needs of the actual addition to population by natural increase and by immigration for less than three years."

And again, "It is a mathematical fact that within twenty years under present conditions our wheat crop will not be sufficient for home consumption and seed without leaving a bushel for export."

For over a quarter of a century the views as expressed by Mr. Hill were the guiding goals of the entire research and educational program of the country and now we are proposing to pay farmers for taking their land out of production.

With such a record of inability of judging the future, I hesitate in venturing any suggestions for avoiding economic storms of the future. If anything stands out prominently from my study and experience, it is the relation of indebtedness to economic depressions. Debts pull down the avalanche of economic difficulties when the influences tending to precipitate a depression become acute.

Indebtedness, however, may not in itself represent the basic trouble but rather the balance between saving and spending. Willard T. Chevalier, in an address, has ex-

plained that debts typify our whole industrial and economic plan which was formulated for the United States by Thomas Jefferson and others under conditions which have long since passed away. In the early days of our country we had the problem of developing our manufacturing industries. It was to the interest of the mother country to keep us strictly in the field of producing raw materials. So, when the yoke of sovereignty of the mother country was thrown off, Jefferson proposed that we should save our earnings and these should be used as capital for developing our manufacturing or the processing of raw materials upon our own account. Later our policies of protecting our industries had something to do with the development which took place, but in the main we as a people proceeded to embrace a philosophy of saving and capitalization which enabled us to become extensive producers. Now savings or earnings which go into investments become at once the basis of production, while earnings that are spent contribute to consumption. If all earnings go into investments, none is left for spending and consumption. If all earnings are, on the other hand, spent for consumption, production lags. That there should be a balance is obvious. Chevalier would urge that saving, thrift, and investments have, as a national ideal, been overemphasized and that with a country grown to adult estate more attention should be given to spending and consumption. Poor Richard's precepts to be frugal and thrifty must now be accepted with some modification. In other words, there should be a happy balance between the ways of the spendthrift which lead to pauperism and those of the tightwad who refuses to buy a reasonable share of the country's production, and thus contributes toward jambing the economic machine. This view concerning the balance between consumption and saving is shared by a number of eminent economists, and the theory seems to be growing in favor. Many of these economists think that this balance may in a measure be controlled by proper regulation.

Nearly every economic depression has been preceded by a period of excessive production stimulated by a high price level and large profits. The present depression is looked upon by some as the natural reaction from the inflationary period of the war. The country has never witnessed a clearer prognostication of the economic results from a certain governmental course of action than that set forth in the memorial sent to Congress April 18, 1917, by two hundred fifty of the leading economists of the United States. These economists, to their everlasting credit, pointed out to members of Congress just what would happen if the financial burden of the war was carried by raising funds by bond issues without the stabilizing influence of increased taxes. It is interesting to speculate as to what might have happened if the advice of these economists had been followed. Since we came so near doing the correct thing once—that is, those who knew the most about it, knew what to do—there is promise of avoiding similar mistakes in the future.

Looking back the agricultural engineer can well be proud of the contributions from his field which have contributed to human well-being. Looking forward there should not be any lack of confidence in our ability to make a larger and more effective contribution to human progress. There is no thought of minimizing in any way the contribution others may make toward the common goal of universal hope, peace, comfort, and well-being. It should be our purpose not to look to the past except to be guided by its lessons. For us there is nothing to mourn for.

J. Sterling Morton, when Secretary of Agriculture, wrote, "American agriculture, in the early days of the Republic, presented to the world the very perfection of domestic comfort and individual independence," and advised the farmers to "keep out of the clouds." An economist of the same period (1894) wrote, "I believe we are in a transition period in agriculture. The influence of machinery has been fully exerted. It is doubtful if the next century will see any important invention which will further eliminate man from the land." In the light of this, consider the admonition of Stuart Chase to the engineers: "Statesmen, philosophers, generals, poets, may lead self-supporting communities, but only engineers may lead a great interlocked economic structure with a score of exposed live arteries throbbing in every metropolitan area."

It appears that an economic depression when viewed from the viewpoint of the agricultural engineer cannot be anything but a challenge. The world needs his services as never before. The agricultural engineer has just begun to learn how he can make his services effective and appreciated. His job is that of not only making the material things which are the foundation of well-being available in greater volume, but it is also his responsibility to cooperate in arranging for their more equitable distribution. Is this not a time when the plea of J. G. Holland, an American author and poet, should apply when he wrote:

"God give us men! A time like this demands
Strong minds, great hearts, true faith, and ready hands.
Men whom the lust of office does not kill;
Men whom the spoils of office cannot buy;
Men who possess opinions and a will;
Men who have honor, men who will not lie."

The ladies in attendance at the 27th A.S.A.E. annual meeting

Can the Advantages of Machine Production in Agriculture Be Retained?[1]

By Walter E. Packard[2]

THIS SUBJECT opens up a field for thought which goes to the very roots of our economic life. Machine production epitomizes America. It has made us what we are and it offers far more than we have been able to grasp. Among other things it has given us productive capacity and leisure, the two fundamental requisites of a high standard of living and of a cultured society. But what are we doing with our opportunities? Our leisure is concentrated in the hands of 12 million unemployed with another 12 million or more dependent upon them. The goods which are the result of our productive capacity remain unsold to clog the wheels of the machines which produce them. Paradoxical as it is, we face danger of chaos at the very threshold of what should be a new day. Our fall, in case we fail to meet the unsolved problems before us, will be the greater because of the heights to which we have climbed.

The task ahead is a difficult one because it involves the weaknesses of human character. If the situation were wholly mechanical, it would be remedied over night, for the basic difficulty is a lack of balance in economic forces which can be corrected. Our difficulty, however, is chargeable in part to the fact that we do not see the problem clearly.

There are five primary industries: hunting, fishing, agriculture, mining, and lumbering. These five industries supply the productive quality to the factor of production land, or to be more explicit, nature. Land or nature, labor, and capital combine to produce wealth. Wealth is created, primarily, to satisfy human wants, but a portion of the wealth produced must be used in the manufacture of machines, tools, and factories which constitute the capital goods required in the productive process.

During an expanding period a large amount of wealth must be diverted from channels of consumption in order to provide the equipment needed to satisfy the demands of a growing population or the wants of a rising standard of living. Wealth must also be used to meet the ordinary operation, maintenance, and replacement needs of industrialized society. During periods of rapid change in methods of production, more wealth is needed for investment in machines and tools than under more static conditions. Beyond these requirements, the investment of wealth in producers' goods is waste.

This, in brief, describes the supply side of the equation of supply and demand. So far as our needs now go, the problem of supply has been solved. We have capacity to produce an abundance for all. The engineer and the scientist have done their work well. We have conquered nature and no longer need to fear its limitations, if we guide our actions wisely.

The demand side of the equation is where our difficulties lie.

There are two definitions of demand which must be clearly distinguished. Never, even in prosperous times, has any appreciable portion of our population even approached a condition of satisfaction with regard to their wants. Consumption could be tremendously increased, if we could buy what we would like to have. Not more than 10 per cent of the farms in these United States have adequate plumbing, which is considered an essential part of modern living. Millions are living in the squalor of slums, although not by choice. Wants of this kind constitute an ineffective demand. To be valid they must have the authority and backing of buying power.

This powerful aid to want satisfaction is itself a product of the productive process. Just as land or nature, labor, and capital produce goods or physical wealth, their employment in production yields rent, wages, and profits. These three forces which emanate from the operation of the three factors of production form the effective demand which must balance supply.

This buying power goes to the owners of the factors of production. In slave days all three sources of buying power were controlled by one class. Where freedom supplants slavery, rent and profits go to the owners of land and capital, and wages go to labor. In so far as a laborer is also an owner of land and capital, he receives buying power from all three factors of production.

The proper running of our economic life depends upon a balancing of supply and effective demand. There must be sufficient effective demand to absorb the products of industry in order to permit continued operation. The immediate cause of the depression was the fact that supply and demand were not in equilibrium. First, let us prove this point and then show why the equation was not in balance.

Our economic structure is geared to the requirements of an expanding program. For more than 100 years from 20 to 30 per cent of our population has been occupied in expansion, in occupying and developing new land, in making new machines, tools, and factories for growing industrial demands, and in creating a new supply of consumers' goods to meet the demands of a rapidly growing population with a constantly rising standard of living.

Just prior to the World War we had reached the practical limits of our territorial frontier and were facing increasing unemployment and depression. The land which remained for settlement required the development of costly drainage or irrigation works to make them productive, and this left a burden on the land, which made pioneering hazardous and in no way as attractive as the homesteading of prairie lands in the Middle West in earlier days.

The war, however, changed the whole situation. Industrial expansion took the place of territorial growth, and the unemployed were put to work at good wages. During that four years of conflict we furnished billions of dollars' worth of wealth to Europe from the surplus produced by our efficient mass production methods. After the war, the inevitable crash was further postponed by installment buying, the expansion in automobile, radio, and oil production, and in electrical development, together with the lavish spending by some during the period of profitless prosperity of the days of consolidations and of holding company financiering. Post-war foreign loans, which were not repaid, also served to postpone the inevitable adjustment which had to be made to meet the requirements of a more static society.

We had been trained in a school which taught thrift and saving, which were proper social and moral traits for pioneer conditions where wealth was needed to develop and equip an industrial society. We now face a situation where these qualities are not so virtuous as they once were. Industrial life must be kept active by demand, which can only come through expenditure of buying power for goods and services which society can offer.

Savings, however, have not been the source of the wealth which has built up huge surpluses for investment.

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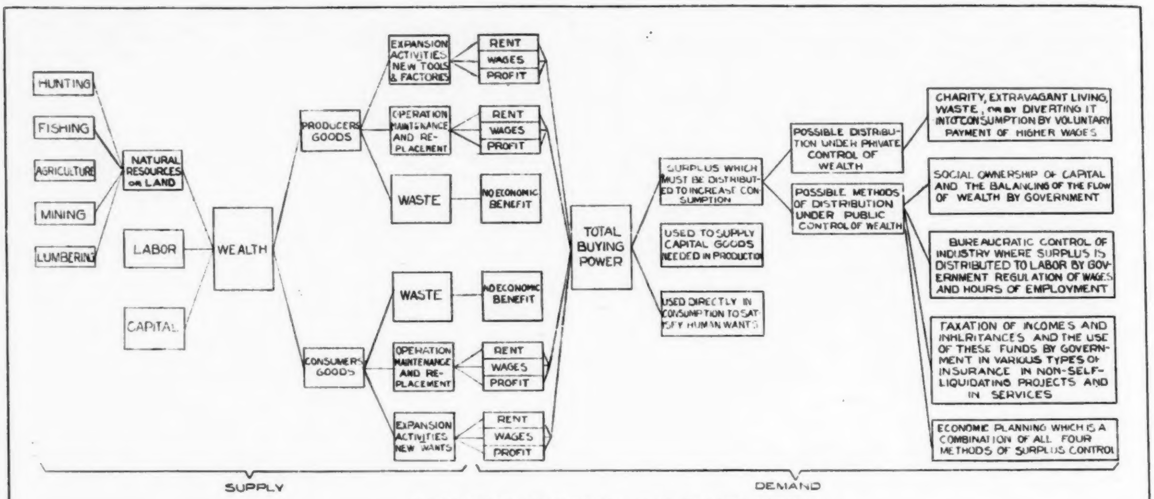
[1]Paper presented at the 27th annual meeting of the American Society of Agricultural Engineers, at Purdue University, June 1933.

[2]Consulting engineer. Mem. A.S.A.E.



PRODUCTION OF WEALTH AND BUYING POWER

(Copyrighted, 1932, by Walter E. Packard)

These came more largely from the excess incomes of those who own and control a major portion of the country's capital wealth. This surplus could not be consumed and quite naturally flowed toward investment in productive enterprise. The overinvestment which resulted created a surplus economy which has broken down our standards of value. Values are based on scarcity, but when every industry, from shoemaking to automobile construction, was overbuilt and every city had more office space than it could use, the scarcity basis of value disappeared, almost over night. Values of stocks and bonds became so uncertain that people began to buy gold as a stable reservoir for value, only to find that there was not enough gold to meet more than a fraction of the gold obligations.

I believe that we do not realize the full significance of this situation. During this century of progress we have occupied a continent concurrently with the unparalleled mechanical expansion of the industrial revolution. Visualize, if you will, the tremendous influence which steam, electricity, and the internal-combustion engine have had on our economic life, to mention but three forces which have come under the control of man within the past three or four generations.

A measure of the effect of the slowing-down process is offered by the fact that there were seven billion dollars less spent in new construction in 1932 than in 1929. This would be employed in providing goods and services for the ones who first received the money. This is the source of our unemployed, and the unemployed will not be put to work until we have shortened hours sufficiently and have broadened the base of our higher standards of living so that the greater demands for consumers' goods can provide profitable employment for more labor and capital.

During the first part of the industrial revolution, machines upset the established order by throwing men out of work. The problems occupied the best thought of the time and brought out the theories of Adam Smith, Ricardo, John Stewart Mill, and Karl Marx. However, the new world, with its outlet for the unemployed and its tremendous demand for the manufactured goods of Europe, which kept up until the World War made us a creditor nation, solved the problem automatically. Propagandists for change of one kind or another appeared here and there during the recurring periods of depression, but by and large they were drowned out by the rush of those who were seeking an opportunity for wealth and advancement.

Suddenly, however, we were thrown back to the conditions which are essentially similar to the conditions which obtained at the beginning of the industrial revolution. Technocracy points to the fact machines are displacing labor which has no place to lay its head. But now there is no new world to conquer, no limitless plains of black prairie soil to subdue and occupy, no great outlet for the surplus wealth which formerly found opportunity for investment in an expanding market.

It is obvious from this analysis that the market for wealth investment in productive enterprises had broken down and that this lack of demand for new capital in industry was the immediate cause of the depression. Millions of men who had depended for their livelihood on expansion activities were thrown out of work and the loss of their buying power carried the trend still further in a downward direction. Now let us see why this lack of balance in the flow of wealth into producers' goods and consumers' goods occurred.

The flow of wealth into the channels of production or consumption is and has been governed largely by the fact that ownership of natural resources and of capital has been concentrated in the hands of a small proportion of the population who were unable to consume all of their income in meeting daily living costs and were forced to do one of three things. They might waste their surplus income in extravagant living, invest it in productive enterprise, or give it away in philanthropic ventures. Obviously investment offered the most attractive outlet. Fortunately, perhaps, the investment of hundreds of millions in foreign securities, which may never be repaid, lessened the degree of overexpansion of capital equipment in this country.

Concentration of wealth in the hands of a small proportion of the population explains why the flow of wealth into capital goods poisoned the investment market by creating a surplus economy where the value-creating force of scarcity was rendered inoperative.

At first we attempted to put a stop to the slowing down of industry by extending government credit with the hope that it might give production an artificial stimulus, which would keep the wheels of production going. Quite naturally it did not work. Industry did not need credit. It needed markets where buying power existed to absorb the products which had accumulated on the shelves.

There was one effective thing to do and that was to go to the aid of industry and business and do for them what, as individuals, they were unable to do themselves—that is, remove the surplus income from investment in production and divert it into buying power for consumption. Three ways to accomplish this end have been suggested. The

first is by social ownership of the tools of production—socialism. The second is to tax incomes and inheritances in combination with taxes on natural resources and franchise values to absorb the surplus. The third is to regulate the flow of surplus funds into investment and to control wages and working hours.

There is, of course, a fourth course, a combination of the other three, plus private charity, which is the course we are following.

Russia has adopted the first alternative, but Russia is in a position diametrically opposite to ours, for Russia is in need of capital goods while we are suffering from an overdose of capital investment. Russia, therefore, has mobilized her wealth, rationed out a lean subsistence to the workers, and has bartered the balance in foreign markets for machines and skill to be used in industrializing a rich but backward country. When Russia gets to the point which we reached in 1928 or before, the flow of wealth into capital goods will be checked and diverted into consumers' goods to be enjoyed by the workers whose standard of living will be raised.

During our history we have accomplished what Russia is now attempting, but we did it in another way, by putting our resources into private hands where the surplus could not be consumed and was therefore forced into production. The desire for private profit stimulated the trend toward complete industrialization.

We have now reached a point where the surplus can no longer be profitably used in expanding our industrial equipment and must therefore be diverted into consumption in a higher standard of living. Whether we adopt the method of control through social ownership, through government taxation, or through government regulation of investments, wages, and hours of labor we will have to accomplish the balancing of supply and effective demand. There is no escape from such a program. We may choose how we want it brought about, but we cannot sidestep the issue. Surplus wealth not needed in industrial expansion will have to be paid in higher wages, or taken by government and spent in non-self-liquidating ways. The money would be spent for sick, old age, and unemployment insurance, for roads, hospitals, schools, parks, etc.

Now how does this apply to the problem of retaining the advantages of machine production in agriculture? We face the necessity of balancing supply and effective demand by increasing consumption through the broadening of the base of our higher standards of living or dropping down into peasantry, with a loss of much of the advantage we have gained through machine production. Perhaps the fact that horses and mules lead the list of advancing agricultural prices is significant. Perhaps also the present back-to-the-land movement, with the demand for small farms, means the beginning of a definite trend. Certain it is that unless a large part of those who have been employed in expansion activity can be absorbed in operation and maintenance activity, through the adoption of shorter hours and a broadening of the base of our higher standard of living, we face peasantry in agriculture and the loss of the advantages of machine production.

Performance Tests of Alcohol-Gasoline Fuel Blends[1]

By R. B. Gray[2]

ON ACCOUNT of the agitation in many quarters favoring the use of alcohol-gasoline blends in automotive equipment, the Bureau of Agricultural Engineering of the U. S. Department of Agriculture conducted field and laboratory tests on tractors and trucks to compare performance characteristics of these blends with gasoline. The laboratory tests were conducted in cooperation with the U. S. Navy Department at the Annapolis Engineering Experiment Station. Octane ratings obtained on each of three gasolines alone average 66.6, and when mixed with 10, 20 and 30 per cent absolute alcohol, gave an average of 74, 79.6, and 84.6, respectively. Tests on an N.A.C.A. engine running at 1200 rpm gave a highest useful compression ratio of 5.6 and a maximum horsepower of 26 hp on 10 per cent blend, and a H.U.C.R. of 6.5 and maximum horsepower of 27.2 hp on the 20 per cent blend.

Road tests of a ½, 1½, and 3½-ton truck over a 20-mile course on paved highways gave the following results: The unloaded ½-ton truck, driven at an average speed of 36 mph (miles per hour), ranged from 16.67 mpg (miles per gallon) on plain gasoline to 15.92 mpg on a 20 per cent blend. The 1½-ton truck with a load of 3380 lb and driven at average speed of 26.5 mph ranged from 12.73 mpg on plain gasoline to 12.62 mpg on a 20 per cent blend. The 3½-ton truck with a 7700-lb load and driven at a governed speed of approximately 14.2 mph ranged from 5.43 mpg on plain gasoline to 5.85 mpg on a 20 per cent blend.

Performance tests are being conducted in routine work on two ½-ton trucks of the same make and model, one running on gasoline and the other on a 10 per cent alcohol blend. At approximately 2000 miles of travel the former averaged 15.6 miles per gallon and the latter 14.6. At this time the cylinder heads were pulled and considerably more carbon was noted in the head on the engine burning plain gasoline.

Belt tests of a standard four-cylinder tractor showed a maximum of 31.8 hp on plain gasoline and 31.6 hp on the 10 per cent blend and very little difference in fuel economy. When plowing, this tractor working under practically the same conditions with both fuels showed a fuel economy slightly in favor of the blend.

Belt tests of this same tractor, but fitted with high-altitude pistons, gave a maximum horsepower of about 30 hp, further loading being accompanied by severe detonation. By using a 10 per cent blend, the power was increased to 35 hp; with 20 per cent, to 43.8 hp; and with 30 per cent, to 44.4 hp. The fuel economy with the 20 per cent blend was better than on plain gasoline.

A two-cylinder, horizontal tractor engine on the belt delivered a maximum power of 31.7 hp on straight gasoline and 32.2 hp on the 10 per cent blend, with a fuel consumption approximately the same.

When plowing, this tractor working under practically the same conditions with both fuels, showed a fuel economy slightly in favor of gasoline.

[1]Report presented at a session of the Power and Machinery Division of the American Society of Agricultural Engineers during the 27th annual meeting of the Society at Purdue University, Lafayette, Indiana, June 1933. A contribution of the Committee on Agricultural Engine Research.

[2]Chief, division of mechanical equipment, Bureau of Agricultural Engineering, U. S. Department of Agriculture. Mem. A.S.A.E.

Correction

THE attention of readers of AGRICULTURAL ENGINEERING is called to the following typographical errors in the paper, entitled "Costs of Storing Chopped and Whole Hay," by Frank H. Hamlin and Fred J. Bullock, in the June issue:

The company connection of both authors is the Papec Machine Company.

In the sixth line above Table I on page 147 the saving should read 0.87 man-hours per ton.

In Table II, line (h), the statement in parenthesis should read "(6% of [a + g] ÷ 2 x b)."

Divisor for Taking Aliquots of Runoff

By R. E. Uhland[1]

ALTHOUGH soil erosion has been active since the beginning of time, it was only within the past few years that a systematic research program was launched to find practical methods of controlling or slowing down the costly wastage.[2] In order to work out control measures it is necessary to have measurements of both soil and water losses from definite types of soil undergoing different cropping treatments on various slopes. When it is realized that soil losses from single rains have exceeded 20 tons per acre and that water losses have exceeded 900 tons per acre by actual measurement, it becomes evident that the necessary measurements cannot be made economically or conveniently by catching the entire runoff, with its suspended soil, from large areas of land.

The use of large tanks placed at the lower end of controlled plats, so that all the runoff water and contained soil are caught, is obviously the most accurate possible method for carrying out such measurements. At the same time, the method is laborious and very costly when the areas involved are of any considerable size. In carrying on the national program of soil and water conservation[3], it is necessary that measurements of this kind be made with areas varying in size from 1/50 acre up to several acres.

The divisor flume[4] shown in Figs 1, 2, 3, and 4 was designed and built by the U.S.D.A. Bureau of Chemistry and Soils at the soil erosion experiment station near Bethany, Missouri, for the purpose of providing a cheap and easy method for measuring soil and water losses from larger areas than can be used where all the runoff is retained. These divisors, designed to take an accurate aliquot sample of the runoff, are made up of a series of the venturi type of flume. The runoff water flowing through the apparatus is divided at the end of each flume, representing a unit of the device as it passes over a step-like drop, so that with five equal divisions a 1/32 (3.125 per cent) aliquot of the total flow is cut out and saved in an appropriately placed tank. With seven equal divisions the device cuts a 1/128 (0.78 per cent) aliquot.

By using one of these small divisor flumes a 4½-by-2-ft tank, such as an ordinary galvanized stock tank, will handle 8.4 in of runoff from a 0.03-acre plat. A 5½-by-3-ft tank will take care of 12.5 in of runoff from a 0.05-acre tract. A No 3 washtub placed inside the tank will catch the runoff from small rains, thus greatly lessening the labor and expense of handling the runoff with its burden of silt. This latter tank (5½ by 3 ft) with the larger divisor will take care of the runoff from a ⅓-acre area.

The soil and water thus collected are thoroughly mixed and passed through a mechanical sampler[5]. The dry matter contained in these samples represents the soil loss for the aliquot. The total soil loss for the area is quickly determined by multiplying the weight of the runoff in the sample tank by 32 for a 1/32 division, or by 128 for a 1/128 division, and the product by the per cent of dry matter in the aliquot. The total weight of the water and soil minus the weight of the dry soil gives the water loss. It has been found that with these two divisors measurements of soil and water losses can be quickly and cheaply made for areas varying in size from 0.02 up to ⅓ acre.

Thus far only two sizes of divisors have been constructed and thoroughly tested. Before making calibration tests the following points were raised:

1. If the flume could be made to take a constant aliquot equivalent to the theoretical value of 3.125 per cent for the small divisor and 0.78 per cent for the larger device, would it be possible to duplicate these aliquots with others of the same type flume?
2. Would the presence of silt in the water influence the accuracy of the device.
3. Would the entrance of water from one side of the concentrating trough influence the accuracy of the aliquot?
4. What would be the height of water in the rear of the first unit of the divisor for different rates of flow into the concentrating trough, and what capacity would these divisors have?
5. Would other than equal divisions at the exit of each of the flume units be satisfactory in a device of this type?
6. Would it be possible to construct these divisor flumes without each being separately calibrated?
7. Can the number of the venturi-type units in a divisor be increased to the point of division that will permit the use of this type of device for handling the runoff from larger areas?
8. Will it be possible to satisfactorily screen out the trash such as might interfere with the proper division and operation of the divisor?

The water supply at the Bethany erosion station proved sufficient for making the necessary calibration tests for the small divisors, but it was inadequate for the larger flumes. The Bethany municipal water and light department kindly provided an adequate water supply for testing the larger divisor.

With the facilities thus made available it was possible to get entrance flows varying from 0.016 to 0.36 cfs for the small divisor and from 0.07 to 1.34 cfs for the larger device. These flows represent runoffs varying from 0.5 in to 12 in per hour for the small divisor

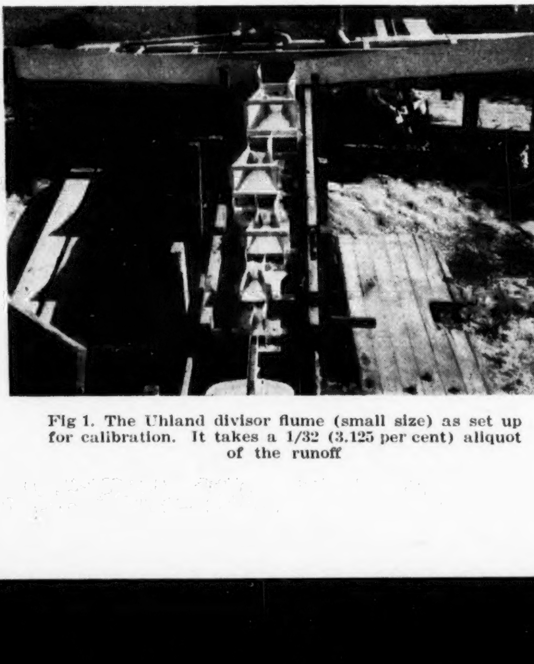


Fig 1. The Uhland divisor flume (small size) as set up for calibration. It takes a 1/32 (3.125 per cent) aliquot of the runoff

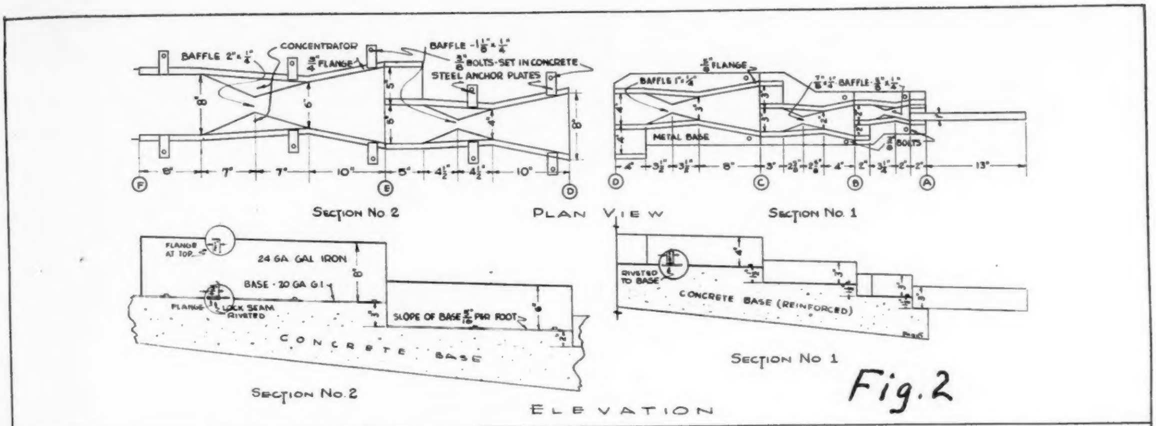
[1]Associate soil scientist, Bureau of Chemistry and Soils, U. S. Department of Agriculture. (Superintendent, Bethany [Missouri] Soil Erosion Experiment Station.)

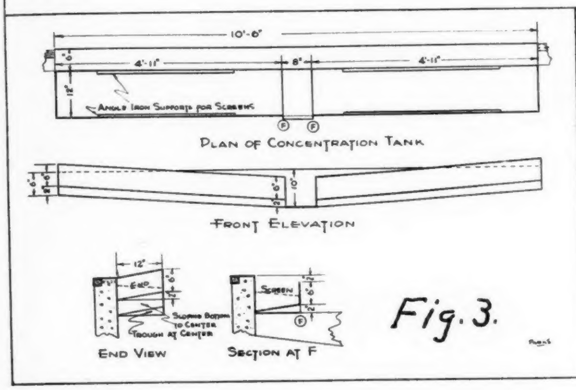
[2]1932 report of the Chief of the U.S.D.A. Bureau of Chemistry and Soils.

[3]The National Program of Soil and Water Conservation, by H. H. Bennett. Journal Am. Soc. of Agronomy, Vol 23, No 5 May 1931.

[4]Merrill Woodruff, University of Missouri, helped with the calibration and assisted in making the needed changes and adjustments for perfecting these divisor flumes.

[5]The field sampler now in use divides the sample in such a way that either duplicate or triplicate samples are secured for laboratory analysis.





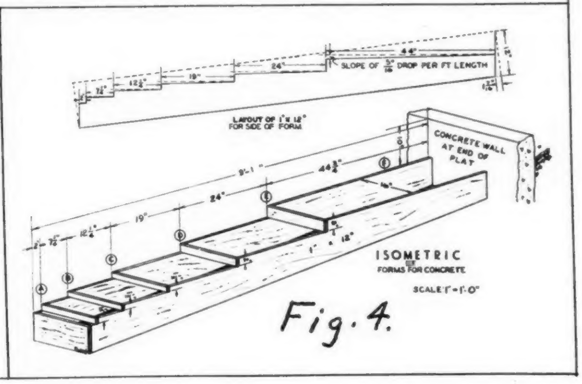


Fig 2. Details of the small-size Uhland divisor flume and the way it sets on the concrete base. Fig 3. Concentrating trough showing placement of trash screen. Fig 4. Details for setting forms for base on which to set divisor flumes

when used on a 0.03-acre plat and from 0.27 in to 5.3 in per hour for the large divisor used on a ¼-acre tract.

The supply tanks were equipped with gages so that it was possible to read the amount of water with a variation of less than two pounds in 600 lb. The rate at which the water entered the divisor was controlled and the time required to run a definite quantity of water into the concentrating trough was carefully checked by use of a stop watch. The aliquot was caught from the outlet spout and weighed in ounces. Knowing the quantity of water that entered the divisors and that discharged from the spout, it was a simple matter to determine the per cent aliquot secured. A glass gage was attached to the upper end of the first venturi type flume of both the small and large divisors so that measurements could be made of the height of water at this point for different rates of flow.

Two of the small divisor flumes, like that shown in Fig 1, were calibrated in this test and one of the larger divisors was tested. Water was entered in the small divisor at rates ranging from 0.016 to 0.36 cfs, and for the larger divisor it was entered at rates varying from 0.07 to 1.34 cfs. Previous calibration tests made by the U.S.D.A. Bureau of Agricultural Engineering at Iowa City showed the small divisor to have a capacity exceeding 0.8 cfs and the larger flume a capacity of slightly under 2 cfs. These tests did not run this high because no runoffs of this intensity will ever be encountered.

An analysis of the results of the tests made on these divisors showed that the maximum deviation in the size of aliquot secured from the small divisors, from the theoretical of 3.125 per cent, was less than 3 per cent and for the large divisor it varied less than 5 per cent. A few changes in the design of the larger divisor will improve its accuracy and these changes are being made.

Since calibrating the two small divisor flumes, eight more of the small divisors, which are in operation at the Bethany station, have been tested and all were found to give aliquot flows which varied less than 3 per cent from the theoretical for any rate of flow. This demonstrates that it is possible to manufacture divisors that will give duplicate results.

In making these tests silt was introduced into the water to determine its effect on the results. Following a rain of August 14, which caused considerable erosion on cultivated land, the runoff material from this land (water and soil) was thoroughly mixed and sampled. The mixture was passed through the divisor by pouring it into the concentrating trough. A sample of the discharge from the small spout was taken, and the per cent dry matter determined and compared with that which entered the concentrating trough. It was found that the material entering the concentrating trough contained 2.31 per cent dry matter and that which was discharged from the trough contained 2.25 per cent of dry matter. Thus the error was only 2.6 per cent which could easily have been accounted for by the material that settled in the concentrating trough. A second test was made whereby a mixture consisting of a measured quantity of water containing a weighed amount of soil was passed through the divisor. The result was that 3.04 per cent of the water was recovered from the discharge trough instead of the theoretical 3.125 per cent, thus showing an error of 2.7 per cent. At the same time 2.89 per cent of the total soil added was recovered through the discharge trough. Considering the difficulty of thoroughly mixing soil and water, together with the

fact that a small amount of sand settled in the concentrating trough, it is felt that the results were satisfactory. Not only was the silt properly divided, but it did not seriously interfere with the division of water, since practically the same aliquot was obtained as when no soil was added.

Fig 3 shows how trash is handled or kept out of the small divisor. A screen of 2-mesh (½-inch mesh) hardware cloth is placed in the concentrating trough so the runoff from the plat falls directly on it, thus allowing all but the trash to go through. At the Bethany station twenty-two of these divisor flumes are now in operation and during a period of 18 months very little trouble has been experienced from trash. A slightly different method of taking care of the trash on the larger areas is to be used.

On the basis of preliminary tests it is believed that with slight modification in design it may be possible to take other than equal divisions at the exit of each unit of the divisor. In trials in which one third of the flow was taken instead of one half, for flows ranging from 0.018 to 0.1711 cfs, the deviation from the calculated theoretical was less than 6 per cent.

Curves showing the relation between the discharge and depth in the back part of the first venturi unit connecting with the concentrating trough was secured for both the small and large divisors. These curves can be used very conveniently for calculating the rate of runoff during a rain. By measuring the height at this point and referring to the curve the rate of runoff is given direct. If the rainfall chart is examined for this same period and the rate of rainfall determined, the per cent of runoff can be easily calculated.

The entering of water from one side of the concentrating trough did not influence the accuracy of the aliquot. The same aliquot was secured when the water was entered from one side of the trough as when it was evenly distributed over its entire length.

The building of the divisor flume may appear rather difficult. Actually they are being manufactured very satisfactorily in a sheet metal shop at Bethany, Missouri. To date (March 1933) fifty-two of the small divisors and five of the large size have been built in this shop. Twenty of the small divisors and two of the large ones are in use at the Bethany soil erosion experiment station, the others having been sent to six of the other stations in various parts of the country.

The flumes are set on concrete bases as shown in Fig 4. This concrete base is leveled very carefully and is well reinforced. The divisors are anchored by small bolts set in the concrete so that the levels can be adjusted quite easily.

The design of the concentrating trough can be adjusted to conform to the size of the plat from which runoff measurements are to be made, but the type illustrated in Fig 3 with the trash screen has proven quite satisfactory.

SUMMARY AND CONCLUSIONS

The findings thus far relative to this new type of measuring equipment appear to justify the following statements:

1. Results from calibrating tests of ten small divisor flumes and one large divisor flume have demonstrated that it is possible to manufacture these devices so that they will duplicate one another.

2. The presence of silt in the water did not affect the accuracy of the flume.

3. Entering the water at either end of the concentrating trough demonstrated that the aliquot conforms to that obtained when the water is entered uniformly over the entire length of the trough.

4. Calibration curves were secured for both the large and small divisors which give the relation between the discharge into the concentrating trough and the depth in the back part of the first venturi unit of the tandum of units.

5. Preliminary tests indicate that it will be possible to design divisor flumes of this type by which other than equal divisions of the runoff can be made.

6. While it is preferable that each divisor be separately calibrated, it was found that divisors constructed by an efficient sheet metal worker and installed using only a level and square gave an aliquot which varied less than five per cent from the theoretical. By calibrating each flume, and making finer adjustments this deviation can be reduced.

7. Since the large size divisor which makes seven equal divisions performed in such close conformity with the smaller size making five divisions, it seems logical to conclude that the size can be safely increased by adding more venturi units.

8. While the problem of screening out trash is somewhat formidable, this nevertheless, is being satisfactorily accomplished with a screen made of 2-mesh hardware cloth. Details for taking care of trash from larger areas are yet to be worked out. It is believed that this can be accomplished, since the finer trash has to be removed only from that portion of the water passing through the smaller venturi units of the divisor flume.

The Factor of Profit in Land Reclamation[1]

By JAMES A. KING

THERE is no single, infallible, all-embracing, universally applicable measuring stick or standard by which to determine the wisdom or the folly of a proposed reclamation project of any size. Such a standard would be possible only in a world of one dimension. Many standards or units of measuring must be applied to any reclamation project, especially to one involving the development of extensive raw lands, if we would evaluate accurately the wisdom of proceeding with that project.

But, world-wide conditions—especially those within the farming business—are throwing the spotlight of attention, as never before in this generation has it been thrown, on the factor of profit. It is true that, when one lets the cold-blooded balance sheet of profit and loss in dollars and cents be the sole arbiter of any agricultural problem or program, he is failing to visualize and appreciate the true inwardness of agriculture. And yet, farming is a business. It must be conducted in accord with sound business principles if it is to grow with this nation and continue to be the stable foundation of a worthwhile civilization.

[1]Extracts from opening remarks at a meeting of the A.S.A.E. Land Reclamation Division at Chicago, December 1931.

So, let us keep ever before us this factor of profit. If profit is always given the consideration which it deserves, land reclamation will soon regain the position of importance which it deserves in the consciousness and the thinking of the general public. Then the time may even come when land reclamation will be found to be the keystone of the arch of agriculture—a solution to the vexing problem of marginal and sub-marginal lands.

We ourselves must not, we must not permit the great mass of farmers, and even the still greater mass of the general public, to lose sight of this fact: The main purpose of land reclamation is to keep in production, as well as to bring into production, those lands which most deserve to be in production; and, as all involved conditions warrant, to take out of agricultural production those lands which can best serve man's needs by being put to some other use.

And this basic principle of reclamation applies as truthfully and as forcefully to a single acre or any fraction thereof in an average, ordinary farm as it applies to any princely expanse of now idle land.

The Pennsylvania System of Mechanized Potato Production[1]

By R. U. Blasingame[2]

THE INDUSTRIAL engineer has worked out complete formulas for the production of manufactured commodities. I feel that the agricultural engineer should do the same thing for agriculture. He can consult leading farmers and the agronomist, plant pathologist, soils expert, and other scientists in agriculture, and secure from them best practices to work out a complete formula for the production, preparation for sale and transportation of all agricultural commodities.

A complete formula has been worked out and used for ten years for the successful growing of potatoes in Pennsylvania. Anyone attending this meeting may visit the farm of Mr. A. C. Ramseyer at Smithville, Ohio, and see this program in complete operation. Mr. Ramseyer has visited Pennsylvania State College and several commercial potato growers in the state and learned the program. This crop will be used as an example illustrating how the agricultural engineer could gather together the best practices in the production of any agricultural commodities.

Every operation in potato production involves the use of a machine; thus it is of an engineering job. For convenience, this program has been divided into several heads:

1. **Legumes.** The first of these is a legume to be turned under. The agricultural engineer can secure from the agronomist and from successful farmers throughout their state best practices in the production of a legume suitable to the crop under consideration. In Pennsylvania, for the potato crop, either soy beans, sweet clover, or a regular clover sod are used. The normal run of two-bottom, 14-inch tractor plow handles the most of these legumes. Some farmers prefer to use the cover crop disk and a chisel for the seedbed preparation. Many commercial potato growers in Pennsylvania seem to feel that a big disk and an orchard harrow or chisel are best for making a deep loose potato seedbed.

2. **Planting.** It has been demonstrated on the Ramseyer farm this year that 30 a of potatoes can be planted per day with a four-row planter. The seed for this purpose is graded so that it is of uniform size and adapted to the planter. This machine plants better than 95 per cent perfect. Deep planting—3 to 4 in—is desirable for potato seed, yet shallow covering controls the disease Rhizoctonia. A deep-planting, shallow-covering machine is now available.

3. **Cultivation.** This Pennsylvania potato production program demands that a weeder be run before the crop is up. This will destroy the first crop of weeds before they develop. Just as the crop is up sufficiently to see the rows, a deep cultivation between the rows is the second operation. Following this, the weeder is run at least once a week or after each rain. As a rule, it is necessary during dry weather to cultivate the crop sufficiently to loosen the ground so that the weeder will take effect. The weeder is always run in the same direction in order to bend the plants over which shades the rows, thereby maintaining the moisture and choking out weeds. The weeder also prunes off potato roots within 1½ in of the surface of the ground causing the crop to grow deep. The weeder is therefore a weed-control tool and a vine conditioner.

4. **Spraying.** A complete system of spraying has been worked out. The spray solution is applied by engine-driven equipment—truck-mounted driven by an auxiliary engine or the power take-off, or pulled by a general-purpose tractor and the sprayer operated by the power take-off. Spraying should be done at from 250 to 400 lb pressure. The spray schedule is definitely classified under three heads:

(a) Foundation sprays which consists of three to four applications. These applications are about one week apart starting as early as the rows can be seen.

(b) The second is the heat series when the temperature is from 85 to 90 deg in the shade. These spray applications are about six days apart with about 2 lb of extra lime per 100 gal of water.

(c) The third series is the blight applications consisting of about three applications. The more it rains, the more frequent these applications should be. Any plant pathologist can predict several days ahead with certainty just when these spray applications should be made.

As a rule, this spray schedule calls for the application of 100 to 150 gal of Bordeaux per acre, and consists of 100 gal of water, 8 lb of copper sulphate and 8 lb of lime.

Iron barrels and an iron stirring rod are used to slake the lime. When wooden barrels and a wooden paddle are used for lime slaking, slivers clog the spray nozzles.

The best method of slaking lime is in use, so that it is neither drowned out with too much water nor receives too little water. Either condition will cause the lime to become granular and clog the nozzles.

5. **Water Supply.** It will be readily understood that to make from 9 to 12 sprays per season, using about 150 gal per acre, will require large quantities of water. Various schemes have been worked out by which water is pumped to overhead tanks in the field or hauled by motor trucks at the time of spraying.

6. **Potato Harvesting.** According to Dr. E. L. Nixon of the Pennsylvania State College, who largely originated this formula or recipe for successful potato production, is of the opinion that harvesting of potatoes is one of the weak links in the procedure. Complaints are coming from the industry with respect to bruising the crop at harvest time. There have been, however, great improvements made recently in power take-off diggers in which the speed of the elevator chain can be conveniently varied to meet the conditions. There is still room for the development of a successful potato combine or harvester.

7. **Graders.** Machinery for grading potatoes has been developed to size the crop in grades recommended by the U. S. Department of Agriculture.

8. **Storage Houses.** Special storage houses have also been developed. Some of these storages are built under ground of concrete, while others are made from the correct insulation and ventilation of Pennsylvania bank barns.

This system of potato production which, when followed completely, and where good land is employed, usually produces from 300 to 600 bu per acre. Before this potato-production formula was developed ten years ago, the average production in the state was about 80 bu per acre, whereas at the present time the production is around 120 bu for the state. In developing the Nixon system of potato production a great many of the details were gathered together from growers throughout the state. I feel that the agricultural engineer has a fine opportunity to gather together in one formula best practices in the production, preservation, and transportation of practically all agricultural commodities. This is a policy which the engineer can develop for agriculture and thereby contribute materially to the wellbeing of those employed in the industry. It remained for the agricultural engineer to write up this system of potato growing which until recently was passed on from grower to grower by word of mouth.

[1]A contribution to the discussion of "An Engineer's Policy for Agriculture" at the 26th annual meeting of the American Society of Agricultural Engineers held at Ohio State University, Columbus, in June 1932.

[2]Head, department of agricultural engineering, The Pennsylvania State College. Mem. A.S.A.E.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture. Requests for copies of publications abstracted should be addressed direct to the publisher.

Milking Machines (Jour. Min. Agr. [Gt. Brit.], 39 (1932), No. 4, pp 317-322). The results of an inquiry to ascertain the present position of mechanical milking among the members of the milk-recording societies of England and Wales are briefly summarized.

These indicate that machine milking was carried out in 373 milk-recorded herds in England and Wales, and that with the exception of about 15 machines all had been installed since 1924 and more than one-half during 1929-1931. This number, however, represents only about 7.5 per cent of the total milk recorded herds. The average size of the herds was 36 cows, compared with a general average of about 23 cows for all recorded herds. This indicates that machines had been installed to a greater extent in the larger herds. Almost all the machines in use were of the single-unit type and were in general use throughout the year. They were driven either by standard petrol or paraffin engines or by independent motors. About 22 per cent of the machines were driven by electricity as compared with less than 6 per cent in 1918. Heavy-oil Diesel engines were used in a few instances.

On account of the limitations of available transportation facilities and the requirements of retail dairies the average time of milking is relatively short, i. e., 1 to 1.5 hours, and in some cases even less than 1 hour. It is here that the value of a machine becomes obvious, quite apart from the actual saving in labor. A herd of from 30 to 35 cows can be milked by two men or a man and a boy, with 3 units, in 1 to 1.25 hours.

In the case of smaller herds no appreciable saving is reported, but in herds above 60 cows there is a clear saving of of about 40 per cent in man power during milking. Producers with herds of between 25 and 50 cows estimate a saving in labor equivalent to 1.5 to 2 men, although the range is extremely wide, varying from 0 to 60 per cent. It was generally agreed that mechanical milking was preferable to average hand-milking but inferior to a really efficient milker.

Celery Washing by Machinery (Jour. Min. Agr. [Gt. Brit.], 39 (1932), No. 4, pp 351, 352, pls 4). A machine developed in England for washing celery is briefly described and illustrated. It consists essentially of a heavy spoked and rimmed wheel, 8 ft in diameter, set on a vertical spindle so that it can revolve horizontally at a height of about 3 ft from the ground. Around the outside of the rim is fixed a series of spikes and hooks in pairs, so placed that each pair will hold a stick of celery horizontally, these spikes and hooks being made of rustless steel to avoid any possibility of staining the celery. The heads of celery are attached to and removed from the wheel while it is being rotated at the speed required for washing, and the rotating of the wheel is carried out by the man who places in position the trimmed heads of celery, which are then carried through a tunnel of sheet iron. Inside this tunnel is fixed a series of sprays in the form of horseshoes. The water pumped into the system is sprayed under pressure into the sides and hearts of each head of celery at different angles, the jets being so arranged that the force of the water assists the rotation of the wheel. The daily output of washed celery from such a machine represents not less than the produce of about half an acre.

The Effect of Aggregate and Other Variables on the Elastic Properties of Concrete, P. M. Noble (Kans. Engin. Expt. Sta. Bul. 29 (1932), pp 27, figs 22). Studies on the elastic properties of sand-gravel concrete in particular and on the effects of various types of coarse aggregate on these properties are reported.

The results indicate that there is a very pronounced difference in the shape of the curves for different types of aggregate. The curves for the hard flinty aggregates are much steeper than for the softer aggregates. The very marked effect of variations in aggregate upon the value of the modulus of elasticity is particularly significant, the extent of this variation being such that it should by all means enter into the design of reinforced concrete structures.

For sand-gravel concrete there is a decided tendency of the value of modulus of elasticity to increase with an increase in the fineness modulus. There is not definite relation between the fineness modulus and Poisson's ratio within the limits of these tests. A maximum value of modulus of elasticity for sand-gravel concrete was obtained for mixes of 1:3:5 to 1:4, with lower values for the richer and leaner mixes. However, the richer mixes show a greater increase with age. Variation in the richness of mix has no pronounced effect on the value of Poisson's ratio. Maximum values of the modulus of elasticity occur for a water-cement ratio of 0.7.

There is a definite relation between the modulus of elasticity and the 28-day strength for concrete made of various types of aggregate. For a given aggregate an increase in the ultimate strength is accompanied by an increase in the modulus of elasticity.

Fuel Economy in Domestic Automatic Heating, H. H. Langdon and H. J. Dana (Wash. State Col., Engin. Expt. Sta., Engin. Bul. 39 (1932), pp 46, figs 11). This is a second progress report of tests on domestic heating plants conducted over a series of years. The conditions of the tests have included (1) a typical hot water heating plant, hand fired; (2) a typical hot water heating plant, stoker fired; (3) a typical hot water heating plant, stoker fired, and with an economizer added; and (4) a specially designed hot water heating plant, with stoker firing when operating under the following conditions: (a) slow rate of coal feed and with clean heat exchanger, (b) fast rate of coal feed and with clean heat exchanger, and (c) fast rate of coal feed and with dirty heat exchanger.

It was found that owing to the inefficiency of hand-firing methods and to poorly designed heating plants only 30 to 40 per cent of the heat in coal ordinarily finds its way into the home. Automatic stoker firing raised the efficiency approximately 15 per cent. By incorporating an economizer in the heating plant, to provide additional heat exchanger surface, 16 per cent of the heat in the coal was saved. The use of a properly designed furnace with adequate heat exchanger surface showed an over-all efficiency, under normal operation, as high as 78 per cent. A dirty heat exchanger on the special test plant reduced the efficiency by 8 per cent.

A comparison was also made of the cost of heating a residence with coal in a stoker-fired heating plant and with oil in the same heater. With oil at 8.5 c per gallon, and coal at $8.50 per ton, the extra cost of heating a residence with oil as compared to a stoker-fired coal in a typical heating plant amounted to 88.5 per cent.

Appendixes describe a special slow flow meter, and report data on heat absorption rates between the gases of combustion and the hot water of the system and on the rate of flow of water in the hot water system under varying operating temperatures.

The Bearing Strength of Wood Under Bolts, G. W. Thayer (U.S. Dept. Agr. Tech. Bul. 332 (1932), pp 40, figs 17). The purpose of this bulletin is to supply information essential to the proper design of bolted joints in timber construction. It presents the results of several hundred strength tests of bolted timber joints in which bolts of various diameters and lengths and timber of both coniferous and hardwood (broad-leafed) species were used. Working values for various types of joint connections, covering a range in direction of bolt pressure from parallel to perpendicular with respect to the grain, are also presented. In addition to working stresses, details of design pertaining to such other features as the required spacing of bolts, the proper margin, and the like are discussed.

Substantially all the detailed information in this bulletin applies strictly to common commercial steel bolts. The stress at the yield point of the common bolts tested was approximately 45,000 lb per square inch, while that of aircraft bolts previously tested was approximately 125,000 lb per square inch. A discussion of the effect of such a difference in physical properties appears in the bulletin, and a scheme for applying the working-stress recommendations to bolts having properties greater than those of the common bolts tested is presented.

The tests made were of two general types. In one the applied load acted in a direction parallel to the grain of the wood, and in the other it was perpendicular to the grain. The tests of bolt-bearing strength of wood parallel to the grain with joints having metal splice plates showed that although the strength properties of the bolt control to a considerable extent the magnitude of the proportional-limit load on a bolted joint, within the limits of the investigation the maximum load appeared to be controlled almost entirely by the strength characteristics of the wood.

With wood splice plates the stresses were somewhat less than those obtained when metal splice plates were used. The proportional-limit values for wood plates, expressed as ratios to the crushing strength, averaged 87 per cent of the corresponding metal-plate values for the two coniferous woods, and 75 per cent for the two hardwoods, over an **L/D** range of from 4 to 12. **L** is the thickness of the timbers in a direction parallel to the axis of the bolt and **D** is the bolt diameter. However, the coniferous woods tested with metal plates averaged 23 per cent better in compressive strength than those tested with wood plates. It appears to be a logical conclusion that the average of the 87 and 75 per cent ratios would very nearly represent the true relation between the average proportional-limit stresses for joints made with wood splice plates and for those made with metal splice plates.

In the tests perpendicular to the grain of the wood using metal splices, it was found that the proportional-limit load for a bolt of given diameter increased up to a certain L/D ration and then slowly dropped off in the larger L/D range. A relatively higher average proportional-limit stress is obtained with wood low in strength than with material of high strength. This in turn again points to the fact that the strength of the bolt in a measure determines the proportional-limit strength of the joint.

No clearly defined maximum loads were obtained in the tests. Usually the test specimens failed under combined tension across the grain and shear, ultimately splitting and shearing from end to end. The average stress under the bolt when this type of failure occurred was much farther above the average proportional-limit stress at large L/D ratios than it was at small L/D ratios. This in a way corresponds to the greater gap between maximum stress and proportional-limit stress that obtained at large L/D ratios than at small ratios when loads were applied parallel to the grain.

The tests with wood splices show that no reduction in load need be made when wood splice plates are used instead of metal. It is assumed, of course, that the load on the splice plates acts parallel to the grain of the plates.

With the bearing stress parallel to the grain and that perpendicular to the grain known, the following formula is recommended for calculating the bearing stress at any angle with the grain:

$$n = pq \div (p \sin^2 + q \cos^2)$$

in which n is the unit bearing stress in a direction at inclination θ with the direction of the grain, p the unit bearing stress in compression parallel to the grain, and q the unit bearing stress in compression perpendicular to the grain.

A discussion is also given of a number of important details of design, such as proper placement of the bolts in a joint, selection of bolt diameter, centering and boring bolt holes, and the like.

An appendix deals with a method of fitting stress curves to the data.

Steam Usage in Vermont Cooperative Creameries, O. M. Camburn (Vermont Sta. Bul. 339 (1932), pp 8).—The results of a special steam study at seven cooperative creameries are reported, which were conducted to determine the evaporating efficiency of the several boilers and the amounts of steam used.

The coal cost of evaporating 1,000 lb of water ranged from 45 to 87 c, the cost of coal accounting for half of the total cost of steam generation. Coal wastage through steam leaks ranged from 177 to 522 lb, averaging $2.43 daily. The straightaway can washers used more steam than did the rotary type. The coal usage for condensing operations averaged 54 lb of coal per hundredweight of plain condensed and 57 lb per hundredweight of sweetened condensed skimmilk. Total steam consumption used for manufacturing casein averaged 14 lb per hundred weight of skimmilk, an average coal usage of 76 lb per hundred weight of dried casein.

A steam turbine cream separator used nearly 8 lb of coal per 1,000 lb of milk separated. The steam usage at two creameries using steam engines averaged 414 lb per 1,000 lb of milk received. The exhaust steam could have been utilized in water heaters to conserve the heat units. The small reciprocal steam pumps used to pump milk cost two-thirds of a cent per 1,000 lb of milk pumped. The steam usage in preheating milk for separation cost 3 c per 1,000 lb of milk heated. Steam usage per hundredweight of cream pasteurized ranged from 4.5 to 10.5 lb, being lowest when the temperature rise was smallest. The most efficient work was done when vats were nearly full.

The Effect of the Degree of Slope on Run-Off and Soil Erosion, F. L. Duley and O. E. Hays (Jour. Agr. Research [U. S.], 45 (1932), No 6, pp 349-360, figs 6).—Studies conducted at the Kansas Experiment Station are reported in which determinations of run-off and erosion were made by means of water applied to soil artificially to simulate rainfall. In one case a tank, which could be tilted so as to vary the degree of slope of the surface, was filled with soil and used to study the effect of slope on run-off and erosion. In another test the plats were placed at different angles on a hillside so that the slope ranged from level to that of the steepest part of the hill. By properly locating the plats large variations in soil profile could be avoided.

The results from the two methods checked very well and indicate that the one to be used will depend on the type of problem to be studied. The run-off was found to increase rapidly as the slope increased from 0 to about 3 per cent grade. The increase in run-off was then very slight for each per cent of increase in slope. The soil eroded increased very gradually until the slope was about 4 per cent, then the increase was found to be more rapid up to about 7 or 8 per cent, after which there was a still greater increase in the rate at which the soil was removed from the plats.

The amount of run-off water required to erode 1 lb of soil decreased rapidly as the slope increased from 1 per cent up to about 10 per cent, after which the decrease was gradual and slight. In some cases the water required to erode 1 lb of soil was less for the 0 and 1 per cent slopes than for a 2 per cent slope.

Soil erosiveness is shown to depend not merely on the physical properties of the soil, but also on the degree of slope and possibly on several other factors. A silty clay loam gave greater erosion on the lower slopes, whereas a sandy soil gave more erosion than did the silty clay loam on steep slopes. The results obtained on large plats in Missouri and Texas have been shown to correspond reasonably well with the results obtained in these tests. This would tend to indicate that small plats having water applied artificially may be used for studying a large number of problems in connection with soil erosion.

Agricultural Engineering Investigations at the Idaho Station (Idaho Sta. Bul. 192 (1932), pp 16-19). The progress results of investigations on drainage and irrigation, combining of field peas, rural electrification, and farm buildings and equipment are briefly summarized.

Agricultural Engineering Investigations at the Michigan Station, H. H. Musselman (Michigan Sta. Rpt. 1931, pp 243-245). The progress results of investigations on combines, hay making, mechanical ventilation, rural electrification, sewage disposal, and supplemental irrigation are briefly summarized.

Book Reviews

"Insulation on the Farm," is the title of a new bulletin issued as a report of the subcommittee on insulation on the farm of the National Committee on Wood Utilization of the U. S. Department of Commerce. The author is Russell E. Backstrom (Mem. A.S.A.E.), insulation specialist of the committee. An advisory committee composed of ten members of the American Society of Agricultural Engineers collaborated in the development of the technical data. The purpose of the bulletin is to point out to farmers how to select the proper type of insulating material for any particular purpose and how to install it to the best advantage. In view of the fact that climatic and other conditions vary in different parts of the country, and that there is not the same need for the use of insulating materials in every instance, the bulletin does not undertake to give general directions to cover each particular case, but it does endeavor to give an understanding of the principles underlying the selection of insulating materials, which will enable the reader to determine for himself how to derive the greatest benefit from the use of insulation. The bulletin gives a complete discussion of the purposes and principles of insulation, insulating properties of materials, and examples for calculating insulating values. It discusses at length why farm structures should be insulated, and also what buildings should be considered for insulation, and where and how they should be insulated. The price of the bulletin is 10 cents per copy and copies may be obtained direct from the National Committee on Wood Utilization, U. S. Department of Commerce, Washington, D. C.

"A Study of the Extension Service" is the title of a book dealing with a two-year study of extension activities in agriculture and home economics in Iowa by a special committee of the staff of Iowa State College, consisting of Dr. J. Brownlee Davidson (Charter Member A.S.A.E.), Herbert M. Hamlin, and Paul C. Taff. Although this study centers about extension work as it has developed in Iowa, it embraces a review of extension the country over, and most of the material is pertinent to the problems of extension activity in other states.

The book will prove particularly valuable to extension administrators, extension specialists, field agents, administrators and teachers of vocational education, and college and university administrators.

The book contains the following chapter headings: I. Movements Leading to the Establishment of the Extension Service. II. The Need and Objectives of Extension Service in Agriculture and Home Economics. III. The Field and Functions of Extension. IV. Relationship of Extension Service to Research and Resident Instruction. V. Administration of Extension Service. VI. The Specialist Staff. VII. The Field Agent System. VIII. The County Extension Organization. IX. The Relationship of Extension Service with the Public Schools. X. Other Extension Service Relationships. XI. A Study of Methods of Extension Instruction. XII. Extension Service in Home Economics. XIII. Boys' and Girls' 4-H Clubs. XIV. Extension Research.

The book may be purchased from College Book Store, Ames, Iowa. Cloth bound copies are $1.25 per copy postpaid, and paper bound copies $1.00 per copy postpaid.

"A National Plan for American Forestry" (Senate Document 12) is the title of a comprehensive report in two volumes just issued by the Forest Service, U. S. Department of Agriculture, setting forth a proposed program on what is perhaps the most comprehensive and exhaustive survey yet made of the forestry situation in the United States. The contents of the report include such important headings as the progress of forestry in the United States, major forest problems, major forest objectives, required activity programs in the national plan, required agency programs in the plan, the cost of a national plan and how it could be financed, legislation required, and the essence of the national plan for American forestry. Requests for copies of the summary of this report or the complete report itself should be addressed to Forest Service, U. S. Department of Agriculture, Washington, D. C.

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Raymond Olney, Editor

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Engineered Human Relations

HISTORICALLY it has always been true, and geographically it continues true today, that countries of low productive capacity per worker have very low standards of living. Trite and obvious as this proposition may be, Professor Chas. E. Seitz in his presidential address at the annual meeting of the American Society of Agricultural Engineers last month saw fit to restore and emphasize it. That such reiteration should be necessary is a sad reflection of the superficial observation and short-range thinking which for three years has kept tongues and type jingling with the word "over-production."

The proposal that the Society found a division on human relations deserves more than the two sentences with which President Seitz mentioned and endorsed it. In the realm of production, agricultural and otherwise, wherein the engineer has been given authority, he has been notably successful. He has given mankind an abundance of every material good thing, and at amazingly low cost.

Yet the finger of blame has been pointed at the engineer (and with him the pure scientist) because commerce, finance, and state craft have failed to keep up with him. He succeeded in production; they failed in distribution, both of goods and of purchasing power. What logic to blame his success for their failure!

Sounder logic would be to widen the realm of the engineer and let him try his hand where others have failed, in commerce and finance. He might not have the same success as he has had in production, but he is not likely to do worse than those who now blame him. So, though it may shock those both in and out of the traditional boundaries of engineering, there is need and promise for the proposed human relations activity in the Society.

Such widening of the engineering realm would speedily involve other than agricultural engineers. But it is logical for our profession to make the beginning, for no other branch of engineering is closer to the social and other human values. Aspersions to the contrary notwithstanding, agricultural engineers never forget agriculture as a "way of life" as well as a means of production. In no other field of engineering are home and occupation so inseparably fused.

If agriculture is a way of life, so may it be said that engineering is a way of thinking. Application of that way of thinking to human relations—economic, legal, and social—seems sufficiently promising to merit serious consideration for the suggested division of human relations.

Profession Shows Its Vitality

FOR MOST of the year between the annual meetings of the American Society of Agricultural Engineers at Columbus and at Lafayette every ecoonmic factor pointed toward a material reduction in attendance. Industry had been driven to the lowest points of sales volume and prices, with continued reduction in the number and pay of personnel. In educational and other public employ the slashes in personnel, pay, and travel funds developed their greatest force during the year.

In the face of that discouraging situation the registered attendance — involving a nominal registration fee and excluding casual visitors — was almost exactly the same this year as in 1932. Coming from California on the west, Maine in the east, from as far south as Louisiana and north to Minnesota, there was no significant geographical difference between Columbus and Lafayette. Possibly a Century of Progress exposition at Chicago as an added attraction may have helped to sustain attendance by those coming from remote points, but it would seem a minor influence to offset the adverse factors mentioned.

The explanation of this gratifying attendance evidently is not to be found in external conditions, but in the vitality and stability of he profession itself, in the merit of the technical programs presened by the Society, and in the somewhat intangible value to the individual of fraternizing with his Society colleagues. This vitality and stability are confirmed by three years of amazing resistance to membership shrinkage, and by a relatively high tenacity of agricultural engineers to their jobs.

Still more gratifying, and perhaps equally significant, is the fact that the women's registration was double that of a year ago. Perhaps the World's Fair should be credited with some of this increase, and surely the hospitality of our hosts has much to do with the rapid growth of family attendance since our members began bringing their womenfolk a few years ago. But besides these things there must be in our members and their kin some human qualities, apart from professional gregariousness, which make their company worth seeking. Without attempting to define these qualities, except to say that hey are no merely social in he society-column sense, they may be rated as a substantial factor in our profession's vitality and stability.

Contributions of the Committees

EACH year in making an accounting of various activities of the American Society of Agricultural Engineers, it is found that the work of its technical committees is constantly taking on increasing importance and significance. In the past few years special effort has been directed toward featuring the results of committee work on the programs of Society meetings. The idea has met with favor generally, and doubtless the time is coming when the technical programs especially will be devoted almost entirely to the presentation of papers that are direct contributions of committee work. As expressed by a past-president of the Society, the "end point" of committee investigations should be the presentation of the results thereof in he form of papers or reports at Society meetings.

Another past-president tells of attending a meeting of another technical Soceity recently, at which the most important papers presented were in the nature of reports of committees, sometimes numbering forty or fifty members, and the results of their work representing several years of study. He also says there were frequently minority reports which served to enliven the discussion.

A good start has already been made toward developing the work of A.S.A.E. committees in this direction. It is doubtless the most important activity which the Society can foster in promoting the development of agricultural engineering technique.

A.S.A.E. and Related Activities

The Purdue Meeting Adds a New Chapter to A.S.A.E. History

INDIANA and Purdue University truly afforded a warm reception to agricultural engineers who rolled into West Lafayette, June 20, 21, 22, and 23 for the 27th annual meeting of the American Society of Agricultural Engineers.

However, whenever actual air temperatures in the meeting rooms endangered the physical comfort of a shirt-sleeved audience, Chairman Aitkenhead's local committee put large batteries of electric fans into operation to save the day. A public address system gave the general session speakers easy command of the air.

Exhibits prepared and displayed by various committees of the Society lined the walls of the main meeting room. A screen and stage set-up by the Committee on Land Drainage flashed with a three-step lighting effect the lesson of ditch cleaning with dynamite. A miniature greenhouse, ultra-violet and infra-red ray bulbs in operation, other special equipment, signs and pictures, presented the story of special farm lighting jobs for the Committee on Agricultural Lighting.

A panel of the most up-to-date types of connection boxes, meters, load centers and fuse boxes for farm use spoke for the Committee on Farm Wiring. The Committee on Dairy Engineering displayed photos of modern equipment, including a milk irradiator. Perspectives, elevations, and floor plans of three designs approved by the Mid-West Farm Building Plan Service were displayed by the Committee on Coordinated Plan Service. A copy of its report, together with photographs, represented the work of the Committee on Row-Crop Management.

Blueprints, photographs, and literature were shown by the Committee on Farm Refrigeration. A working display of a new thermal motor protective device, supplemented by other motor control and protective devices, and literature called attention to recent progress in motors for the Committee on Farm Motors.

The largest exhibitor was the Committee on Extension. It displayed a Kentucky brooder, Wisconsin model dairy barn sections, working models of the Pennsylvania burglar alarm system and hay mowing chute, and other devices, pictures, display cards, and literature giving some indication of current extension methods as well as of the equipment and practices being recommended.

Representatives of most of these committees were on hand to answer questions and supply additional information on the work of the committees. In addition to the committee offerings there was a notable presentation of some of the results of the recent "Inquiry into Changes of Quality Values of Farm Machines." Still another was a group of pictures of the new Rosenwald Museum of Science and Industry.

College Division Session

Mr. Wm. Aitkenhead called Wednesday morning's session to order on time and turned it over to Deane G. Carter, chairman of the College Division. R. D. Barden acted for C. O. Reed in leading the conference of the Committee on Agricultural Engineering Education. Under his guidance the group achieved its objective for the conference—a thought-stimulating discussion without any attempt to arrive at immediate conclusions and recommendations. Much of the discussion centered about the relative importance in teaching, of knowledge of subject matter and of pedagogic practice, with subject matter apparently in first place. Opinion of those present indorsed the committee's efforts, and a continuation of its work.

In a show-up of committee work Chairman Carter called attention to the fact that a report of the annual meeting of the College Division Advisory Committee is to be published in an issue of "The Confessor." No further report was called for from the Committee on Agricultural Engineering Education. Speaking for the Committee on Cooperative Relations with industry, Dr. J. B. Davidson reviewed its field of activity, calling attention to the classes of industry concerned, namely (1) those using agricultural products as raw materials, (2) those converting waste materials of agriculture, (3) those manufacturing farm equipment, and (4) those manufacturing materials used on farms, especially those used for structures. Dr. Davidson mentioned that the present would be an inopportune time for the Committee to start an extensive program. He pointed out that the Committee's apprenticeship plan, by which agricultural engineering graduates are inducted into the organization of manufacturers, is temporarily practically inoperative, due to the low demand for men.

Chairman Carter read a statement from E. W. Lehmann, chairman of the Advisory Committee to the Rosenwald Museum of Science and Industry, to the effect that while its work is at a standstill at present, the Committee stands ready to consider and advise on any questions referred to it.

V. R. Hillman, chairman of the Committee on Student Branches, read a report in which the Committee recommended (1) that proposed student branch constitutions and by-laws, and changes in the same, be referred to it for study and recommendation before being presented to the Society's Council for action, and (2) that graduate students, under certain conditions, be accepted as student members.

J. D. Long advised that the Committee on Publication Standards had no report to make this year.

E. G. Welch, reporting for the Committee on Agricultural Engineering Extension, called attention to the biennial extension conference feature of the Committee's program. This not being a conference year, the Committee's efforts were concentrated on another project—to indicate the extent to which agricultural engineering extension is meeting the needs of agriculture. This took the form of a survey of the adjustment of extension programs to emergency conditions. Mr. Welch said that in the survey 27 states reported 50 projects adapted to emergency situations, and called attention to the publication of the survey results by the U. S. Department of Agriculture.

H. B. Walker reported that the Committee on Agricultural Engineering Research held no meeting during the year, due to the large number and wide geographical distribution of its members. He read a paragraph from a report of the Subcommittee on Reclamation as an example of a clear definition of the Subcommittee's mission.

M. A. Sharp spoke for Chairman J. P. Schaenzer of the Committee on Vocational Agricultural Engineering Education. He commented with satisfaction on the interest being shown in the teaching of agricultural engineering. Papers on the day's program by M. M. Jones and L. M. Sasman, he said, were secured largely through the efforts of Mr. Schaenzer and the Committee. He pointed out that the Committee believes there would be an opportunity to improve extension work by the employment of an itinerant extension teacher trainer.

At the conclusion of the committee reports Chairman Carter gave opportunity for the raising of any objections, and then declared the reports approved as presented. The balance of the morning session was given to

the scheduled paper by M. M. Jones.

Two addresses by men who are educators rather than agricultural engineers featured the afternoon session. L. M. Sasman, state supervisor of agricultural education for Wisconsin, in speaking on the "Relation of Agricultural Engineering to Vocational Agriculture," pictured the importance and scale, the fields covered, and opportunities for the A.S.A.E. to help with vocational agricultural engineering education. Dr. George Brandenburg, head of the department of education at Purdue University, supported his paper on "Education and Material Success," with figures, some of them the result of his own research over a long period of years.

Reductions, effective and proposed, in public funds for agricultural engineering research bore the brunt of discussion in the conference on agricultural engineering research. In the face of 20 to 30 per cent reductions, many of the department heads, it appeared, will try to keep their personnel together and continue their most important work by reducing actual operating expenses to a minimum. Great interest was also shown in the possibility of developing quantitative methods of evaluating agricultural engineering research, and thus providing tangible evidence of its value to agriculture.

R. W. Trullinger pointed out that administrators, before authorizing proposed research on a certain operation or group of operations, or on one or more pieces of equipment, would like to know the relative importance of such operations or equipment in terms of crop-value units. Dr. Davidson named other terms in which research might be evaluated, including number of projects, number of workers, number of proposed projects, number of publications, permanency of program, and public acceptance. H. H. Musselman called attention to several short, inexpensive projects which have produced results of great direct value to farmers, and to their ease of evaluation. Arthur Huntington remarked that agricultural engineers are fortunate in being called upon to evaluate their work because that will help them to appreciate its value. Mr. Trullinger urged that agricultural engineers work into and make themselves indispensable in the commodity branches of agricultural research.

On the subject of methods and measurements H. B. Walker emphasized the need of set-ups and methods which another worker could use and secure comparable results. He also pointed out the danger of getting too little data, and suggested that the younger research men study up on methods of measurement. A suggested inventory of agricultural engineering research personnel, projects, publications, special equipment, etc., received much favorable comment.

President E. C. Elliott, of Purdue University, and Mrs. Elliott graciously received members and guests of the Society at their home Wednesday afternoon at 4:00 o'clock. There all enjoyed a light lunch served on the lawn and a pleasant social hour.

Round Table Conferences

Wednesday evening concurrent dinner meetings were held by the extension men, the agricultural engineering department heads, and the student members.

L. F. Livingston opened the extension meeting by naming next year's Committee on Extension. He named Earl G. Welch, general chairman; K. J. T. Ekblaw, chairman of the industrial group; and R. D. Barden, chairman of the college group. Mr. Welch conducted the balance of the meeting, the central thought of which was "extension in the present emergency." S. P. Lyle opened the subject with remarks on extension from a national viewpoint. "Land Improvement," "Structures," "Rural Electrification," and "Power and Machinery," were the subjects of talks by representatives of both college and industrial extension. For the college group the subjects were covered in the order named by I. D. Wood, W. G. Ward, T. E. Hienton, and V. S. Peterson. In the same order John Swenehart, C. F. Miller, E. A. White, and H. H. Sunderlin represented industrial extension. Mr. Livingston claims a record for the program in the speed with which the meeting progressed, twelve speakers being heard in 65 minutes. The program was followed by a short recess and then general discussion.

After their dinner and introductions all around, the student group accepted the invitation of the agricultural engineering department heads to join them in hearing a talk by Dr. C. H. Robertson on "Mass Education in China." A professor of mechanical engineering at Purdue 30 years ago, Dr. Robertson turned missionary for the Y.M.C.A., went to China, mastered its language and customs, set up a laboratory, and travelled extensively over the country interpreting to the masses of Chinese with lectures and demonstrations all that is best in western civilization and progress. He told many interesting stories of Chinese agriculture, social customs, and culture, and of their influence on his methods of mass education.

In a session following Dr. Robertson's talk, V. R. Hillman, chairman of the Committee on Student Branches, urged the students to meet each other and as many of the older members of the Society as possible. He reminded them of the special registration blanks to be filled out by them, and called for reports from the student branches represented. Illinois, Kansas, Minnesota, Nebraska, Oregon, Pennsylvania, South Dakota and Virginia responded.

The Oregon branch recounted its story of its bus trip to the meeting. Known on its own campus as a new but highly active organization, it began early to lay deliberate plans to extend its field of activity. It bartered its services in plowing 70 acres of land for a neighboring farmer last year, in return for the rental of 30 additional acres for its own use. A crop of corn on those 30 acres provided the means of chartering a bus and preparing it to carry 16 students, W. J. Gilmore and Clyde Walker of the agricultural engineering staff, together with camping equipment, across the country. In addition to the A.S.A.E. meeting, their trip itinerary included a Century of Progress exposition, and several college agricultural engineering departments and farm implement factories. The branch indicated that it is already planning a coast-to-coast trip two years hence.

President Seitz and College Division Chairman Carter commended all of the students for their interest in the A.S.A.E. meeting and spoke from personal experience on the relation of activity in the Society to activity and progress in the agricultural engineering profession.

Dr. Elliott Welcomes Engineers

The opening general session Thursday morning, June 22, followed schedule closely. After calling the meeting to order Local Committee Chairman Aitkenhead introduced President Elliott of Purdue University. In officially welcoming the Society to Purdue, President Elliott pointed out that agricultural engineering is a distinctive profession, that it is following the same course of evolution followed by other professions, that it has an unusually broad field, and that agricultural engineers should be properly prepared for the job they attempt. He suggested a closer definition of the agricultural engineering field agreeable to other branches of the engineering profession.

Mr. Seitz, in the president's annual address, and A. A. Potter, dean of engineering at Purdue University, held closely to their subjects and were well received.

The session closed with the 15-minute papers presented by the three winners in the 1933 Student Papers' Competition, as follows: T. H. Kummer, Alabama Polytechnic Institute, paper entitled "The Plow Moldboard on Equal Pressure Surface"; Donald Christy, Kansas State College, paper entitled "The Design of a Terracing Machine"; J. H. Lillard, Jr., Virginia Polytechnic Institute, "Effect of Different Fertilizer Treatments on the Draft of the Plow."

L. J. Fletcher read the paper by Walter E. Packard on the Friday morning program, and Raymond Olney read the paper by Dr. C. H. Dencker and Dr. N. L. Wallem. With these exceptions

the general sessions followed schedule. Unusual interest was shown in the papers.

* * *

Friday evening the Society added another distinguished dinner to its score of annual climactic social events. Toastmaster H. B. Walker took occasion to introduce briefly David Ross, trustee of Purdue University, and Arthur Huntington, incoming president of the A.S.A.E. During an excellent and well-served meal a colored quartet and a cornet solo were entertainment features. Mr. Seitz, as president of the Society, officially presented the McCormick medal to Dr. J. B. Davidson, who, in accepting it, responded briefly with sentiments of appreciation.

Unfortunately, George Ade, Hoosier humorist scheduled as the main speaker on the program, was unable to attend the dinner due to illness. He sent a representative, however, who spoke briefly. He also sent copies of two of his essays, "Indiana," and "Single Blessedness," which Dr. Elliott read, and supplemented with occasional comments of his own, to the great amusement of all present. The A S A E. party was given, and many accepted, an invitation to participate in a summer student dance in the same room following the dinner.

* * *

Those who happened along the west side of the Memorial Union Building at the right time, shortly after noon Thursday, saw shades of the past revived for the sake of contrast. Arthur Huntington, incoming A.S.A.E. president, stepped up into a buggy of ancient and distinguished record, picked up the reins, was photographed, and was drawn away for a quiet drive by a horse which had reached the age of discretion.

Mr. Huntington was officially inducted into the presidency of the Society with a brief ceremony at the close of Saturday morning's general session.

Photographs of the members and visitors were taken Thursday afternoon, and of the ladies on Friday afternoon.

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At the business meeting the minutes of last year's meeting and the report of the Society's secretary-treasurer were read and approved. L. J. Fletcher, reporting on activities of the American Engineering Council, called attention to the availability and merits of its study on "Production, Consumption, and Distribution." He also stated that activities of Council on behalf of the A.S.A.E. are increasing.

George C. Krieger, chairman of the Membership Committee, reported that 51 new members joined the Society during the year. He indicated that with more membership work and improving employment conditions, a larger number should be expected to apply for membership during the coming year.

Col. O. B. Zimmerman, chairman of the Committee on Medals and Awards, recommended an increase in the number of the Society's honorary members, and invited the presentation of names of persons thought deserving of this honor, together with a record of such persons' services upon which the recommendations are based.

L. J. Fletcher brought up the question of whether or not most of the members wanted to have the annual meeting on the West Coast next year as originally planned, or in some more central location. A central location for next year's meeting was slightly favored by those entering the discussion. J. C. Wooley for Missouri, E. W. Lehmann for Illinois, H. H. Musselman for Michigan, and B. B. Robb for New York invited the Society to hold its 1934 annual meeting in each of those states.

R. W. Trullinger explained the organization and purpose of the Jury of Awards of Honor.

Mr. Fletcher reported unofficially for the Canadian Section and announced that it will meet some time during and in connection with the World Wheat Conference at Regina, Saskatchewan, July 24 to August 5.

J. R. Haswell announced a dinner for North Atlantic Section members the following evening, and plans for the next annual meeting of the Section.

Mr. Olney acted for and in the absence of W. G. Kaiser in reporting on Engineers' Week at a Century of Progress exposition.

Technical Division Programs

The technical divisions held simultaneous sessions Thursday and Friday afternoon as scheduled. In the Power and Machinery Division Vice-chairman R. B. Gray presided in the absence of Chairman W. L. Zink. Special interest was shown in the symposium on agricultural engine fuels, and in the further development of rubber tires for tractors. The Division decided to hold its usual meeting at Chicago in December.

In the rural electrification sessions the symposium on uses of light in agriculture drew most attention. There was little variation from the announced program.

Henry Giese, in reviewing his stewardship as chairman of the Structures Division, recommended continuation of the cooperative plan service project and the preparation of a handbook covering data of interest to the division members and not otherwise readily available. A Committee of Coordinated Activities to set up machinery for carrying out the Divisions projects was suggested, and Mr. Giese was later named chairman of this new committee.

Great interest was shown in M.A.R. Kelley's paper on Wisconsin dairy barns, which was the second of a two-part report on a research project by Mr. Kelley. Reports were presented during the latter part of the Friday afternoon session by the committees of this group.

The Structures men voted to hold the usual division meeting at Chicago in December. C. F. Miller, incoming chairman of the Division, urged increased effort on membership. Discussion on the various matters continued until 6:00 p.m.

L. F. Livingston acted as chairman of the Land Reclamation Division session in the absence of James A. King. Wm. L. Barker was present and spoke for his chief, W. W. Tinker, regional forester, Lake States Region, on "The Federal Unemployment Relief Plan." In place of S. H. McCrory, whose paper was not available, E. W. Lehmann explained how the soil erosion control phase of the Civilian Conservation Corps activities is to operate in Illinois. The remainder of the program was held as scheduled.

* * *

The coolest meeting room during the four days was that of the Saturday afternoon session, the storage cellar of the Coffing Brothers apple orchards, where some 40 men gathered to see the meeting through to its logical conclusion. In addition to the scheduled papers Homer Coffing, W. J. Parvis, A. D. Edgar, T. E. Hienton, and others contributed to the discussion. The Coffing Brothers stationary spraying and cold storage equipment was open for inspection.

By way of diversion the research and extension men renewed their annual softball feud. The research men discovered a way to bring in four runs while holding the extension men to a goose egg.

Records showed 175 paid registrations, and a count of the students, ladies, children, and other guests brought the total known attendance up to 289, which was considerably in excess of the attendance a year ago.

New Data on Power and Machinery in Agriculture

The most recent data, compiled from a number of different sources on power and machinery in agriculture, has just been issued by the U. S. Department of Agriculture as Miscellaneous Publication No. 157.

Owing to the fact that in some regions changes from human to animal power and from animal power to mechanical power has been slow, while in other regions they have been rapid, and also owing to the fact that in recent years no adequate records have been made of the number, time, and use of power units and implements on farms, it has been difficult to obtain data that would show with reasonable accuracy the part that power and machinery has played in American Agriculture. However, available information does show some very definite trends that may have a de-

cided bearing on future developments.

The data used in the bulletin just issued by the U.S.D.A. has been obtained chiefly from federal and state reports, from individuals associated with state agricultural colleges, and from farm equipment manufacturers. A considerable part of the statistical matter presented is based on reports of the Bureau of the Census, U. S. Department of Commerce, and of the Bureaus of Agricultural Economics and of Agricultural Engineering, U. S. Department of Agriculture. Lacking definite information in some instances, it has been necessary in this bulletin to make estimates based on available information, and while such information is believed to be representative, the authors caution against construing these estimates as positive findings.

The bulletin is a contribution from the Bureau of Agricultural Engineering, U. S. Department of Agriculture, and is for sale by the Superintendent of Documents, Washington, D. C., at 5 cents per copy.

Agricultural Engineering Program at World's Grain Conference

AN IMPOSING list of agricultural engineers — all members of the American Society of Agricultural Engineers — are featured on the program to be presented during the World's Grain Exhibition and Conference at Regina, Saskatchewan, July 24 to August 5. The program will be presented under the auspices of the agricultural engineering group of the Canadian Society of Technical agriculturists.

The engineering group is scheduled to hold a joint session with the agronomy and soils groups of the C.S.T.A., and another session with the economics group. In addition it will present a general program at one of its sessions, and at another session it will feature the subject of farm power and machinery.

The dates of the various sessions have not yet been announced, except that the first part of the agricultural engineering program starts Monday evening, July 24.

The program is still tentative, but the following are the members of A.S.A.E. who are scheduled to present papers, including the titles thereof: E. J. Stirniman, consulting agricultural engineer, "Mechanization of Agriculture in Russia"; L. G. Heimpel, agricultural engineer, Macdonald College, "Possible Improvements in Mechanization of Eastern Canadian Agriculture"; J. E. Newman, Institute for Research in Agricultural Engineering, University of Oxford, "Combine Harvesting in England"; H. E. Murdock, professor of agricultural engineering, Montana Agricultural College, "Hitches Used in the Grain Growing Sections"; L. J. Fletcher, agricultural engineer, Caterpillar Tractor Company, "Recent Development in Mechanization in Wheat Production"; S. H. McCrory, chief, Bureau of Agricultural Engineering, U. S. Department of Agriculture, "Agricultural Engineering Research"; J. Macgregor Smith, professor of agricultural engineering, University of Alberta, "Improving Agricultural Engineering Methods"; E. A. Hardy, professor of agricultural engineering, University of Saskatchewan, "Burning Heavy Fuels in Farm Tractors"; R. P. Frey, assistant professor of agricultural engineering, University of Saskatchewan, "The Six-Volt Wind Electric Plant"; H. B. Dinneen, vice-president in charge of engineering, Minneapolis-Moline Power Implement Company, "The Deep Furrow Drill"; G. D. Jones, agricultural engineering, Cleveland Tractor Company, "Improved Tillage Methods," and Guy T. M. Bevan, chief engineer, Massey-Harris Company, whose subject has not yet been announced.

Leonard J. Fletcher, past-president of A.S.A.E., and agricultural engineer, Caterpillar Tractor Company, will officially represent the Society at this exhibition and conference.

The Canadian group of agricultural engineers extends a cordial invitation to all who are interested in its program to attend any or all sessions.

Architects and Engineers Needed

PRIVATE architects and engineers throughout the country will be engaged by the U. S. Treasury Department to prepare the plans and specifications for a large federal building program which may reach a total of $200,000,000. The Treasury Department has adopted this policy in order that professional men who have not had employment will benefit by the large expenditure for new federal buildings.

The Treasury Department, with the cooperation of the American Institute of Architects, is assembling the records of architects throughout the country. Each known architect has or will receive a prequalification blank, which should be forwarded to reach the Treasury Department promptly.

As the procedure adopted for enrolling architects could not be utilized satisfactorily to obtain the same character of information concerning engineers, American Engineering Council is compiling state lists of engineers and engineering firms that customarily engage in construction of buildings of the monumental character usually typifying those built by the federal government.

Any qualified engineer desiring to participate in the Treasury Department's building program should send to L. W. Wallace, Executive Secretary, American Engineering Council, 744 Jackson Place, N. W., Washington, D. C., a complete statement, in duplicate, of his professional record, with a citation of significant references.

Personals of ASAE Members

W. M. Hurst, associate agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture, is one of the authors of Miscellaneous Publication No. 157, entitled "Power and Machinery of Agriculture," recently issued by the Department.

H. E. Lacy, agricultural engineer, Georgia State College of Agriculture, recently received his master of science degree from that institution. He is co-author of two bulletins, entitled "The Combine Harvester in Georgia" and "Stationary Spray Plants," recently issued by that institution.

J. Macgregor Smith, professor of agricultural engineering, University of Alberta, is one of the editors of a new bulletin on the header barge method of harvesting grain, just issued by that institution.

New ASAE Members

Donald Christy (J) — Agricultural engineer, Scott City, Kansas.

Walter Godchaux, vice-president in charge of agriculture, Godchaux Sugars, Inc., New Orleans, La.

T. H. Kummer (J) — Agricultural engineer, Alabama Polytechnic Institute, Auburn, Ala.

Charles H. Middleton, salesman, Cleveland Tractor Company, Cleveland, Ohio.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the June issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Victor L. Stedronsky, junior mechanical engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Box 428, Leland, Miss.

Transfer of Grade

William J. Godtel, Culbertson, Nebraska. (Junior to Member.)